ARCHIVES OF OPHTHALMOLOGY

VOLUME 37 (old series Volume 94) FEBRUARY 1947 NUMBER 2

COPYRIGHT, 1947, BY THE AMERICAN MEDICAL ASSOCIATION

SURGICAL METHODS OF TREATING PARALYSIS OF THE SUPERIOR OBLIQUE MUSCLE

WILLIAM E. KREWSON III, M.D.
PHILADELPHIA

ISOLATED paralysis of the superior oblique muscle is frequently encountered. According to Bielschowsky,[1] it is exceeded in occurrence only by paralysis of the external rectus muscle. Involvement of the superior rectus muscle is often encountered, but usually this is associated with paralysis of one or more of the other muscles supplied by the oculomotor nerve. While probably the most frequent, paralysis of the superior oblique is certainly the most puzzling single vertical paralysis with which the ophthalmologist has to deal. Congenital paralysis is not common, but bilateral involvement, usually thought to be congenital, is sometimes seen. The literature, however, records relatively few cases in which treatment has been carried out, and in these a great variety of surgical procedures have been offered. In fact, at some time or other almost every muscle attached to the globe has been used in one way or another. It is interesting to compare and analyze some of the methods employed.

PATHOPHYSIOLOGY

Before criticizing the various possible surgical procedures that have been proposed, it is well to have in mind the pathologic physiology of unilateral paralysis of the superior oblique muscle. This was discussed in detail in an earlier presentation.[2] The normal muscle has for its primary function the act of intortion, and for its secondary functions downward rotation and outward rotation (fig. 1 *A*). From the position of "eyes front" the superior oblique intorts the corneal meridian and rotates the eye downward and outward. As the eye is rotated outward, the functions of intortion and outward rotation are increased, while the function of depression is decreased. On inward rotations (fig. 1 *B*), the tortional and horizontal effects are minimized, while

From the Department of Ophthalmology, Graduate School of Medicine, University of Pennsylvania.

Read at a meeting of the College of Physicians of Philadelphia, Section on Ophthalmology, Oct. 18, 1945.

1. Bielschowsky, A.: Lectures on Motor Anomalies, Hanover, N. H., Dartmouth College Publications, St. Louis, Ophthalmic Publishing Company, 1940.

2. Krewson, W. E., III: Comparison of the Oblique Extraocular Muscles, Arch. Ophth. **32**:204 (Sept.) 1944.

that of depression reaches its maximum. The superior oblique is synergistic with the contralateral inferior rectus, since the actions of the two muscles are similar for their respective eyes. The direct antagonist of the superior oblique is the homolateral inferior oblique.

With paralysis of the superior oblique the eye will be turned up and in and extorted (fig. 2 *A*);[3] this is primary deviation, with the normal eye fixing. False projection will be down and out, the false

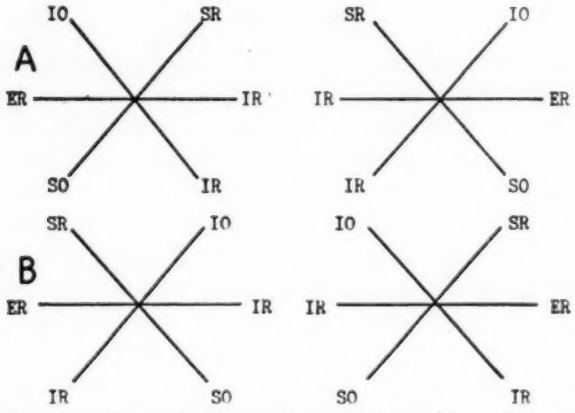


Fig. 1.—*A*, action of muscles from the primary position; *B*, muscles grouped as maximum elevators and depressors.

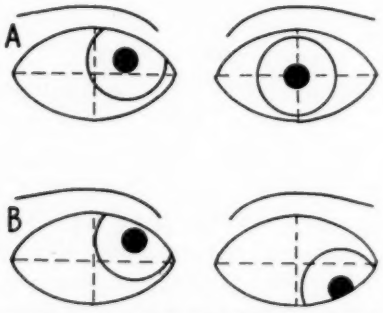


Fig. 2.—*A*, deviation up and in (primary deviation) and extortion in paralysis of right superior oblique; *B*, limitation of downward rotation.

image being tipped to the opposite side. The diplopia is annoying, but the tortional effects cause by far the more aggravating symptoms. The face is frequently turned down and to the opposite side, and the head may be tipped to the opposite shoulder. There is limitation of rotation downward, and this is most marked when looking down and in, where

3. In this paper, for purposes of comparison, all diagrams of eyes and muscle action are based on paralysis of the right superior oblique muscle, except those pertaining to bilateral involvement.

the muscle normally acts as a maximum depressor (fig. 2 *B*). It is in this field, down and to the opposite side, that vertical diplopia is greatest. Since the paralytic eye is deviated inward, homonomous diplopia is encountered, although this may be nullified by a preexisting exophoria. In cases of long-standing paralysis secondary contracture of the direct antagonist, the homolateral inferior oblique, is sometimes found (fig. 3); this produces elevation of the paralytic eye on rotation to the opposite (normal) side.

Fig. 3.—Elevation of paralytic eye on rotation to opposite (normal) side due to secondary contracture of homolateral inferior oblique.

When the paralytic eye fixes, the normal eye is forced into secondary deviation by stimulation of the synergistic contralateral inferior rectus, causing the normal eye to turn down and in (fig. 4 *A*). When the subject is looking downward, especially down and to the opposite (normal) side, overaction of the synergistic inferior rectus may be noted (fig. 4 *B*). Some observers believe that there is an inhibitional palsy of the opposite (normal) superior rectus. Tilting of the head and

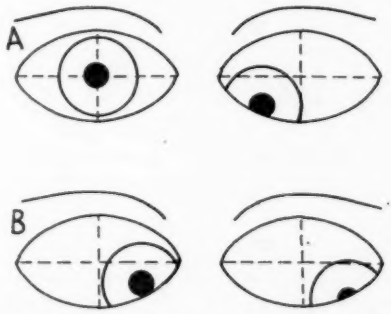


Fig 4.—Paralytic (right) eye fixing. *A*, secondary deviation of normal (left) eye; *B*, overaction of synergistic, contralateral inferior rectus on looking down and to the normal side.

turning of the face are modified by secondary contractures and choice of the fixing eye.

In cases of bilateral paralysis of the superior oblique the eyes are often found to be comitant; secondary deviation is not greater than primary deviation, and diplopia and torticollis are usually absent. The diagnosis is dependent on the finding of double hyperphoria (hypertropia), which is more marked on the right in the left lateral rotation and

more marked on the left in right lateral rotation. In each eye maximum limitation of rotation occurs on looking down and to the opposite side.

In consideration of the various methods of treatment, this review is limited to surgical procedures only, and the use of prisms, exercises and similar methods is not included.

TENOTOMY OF SUPERIOR RECTUS MUSCLE

Müller [4] has described the operation of tenotomy of the homolateral superior rectus (fig. 5 *A*) for relief of symptoms in paralysis of the superior oblique muscle. Although the procedure has been widely

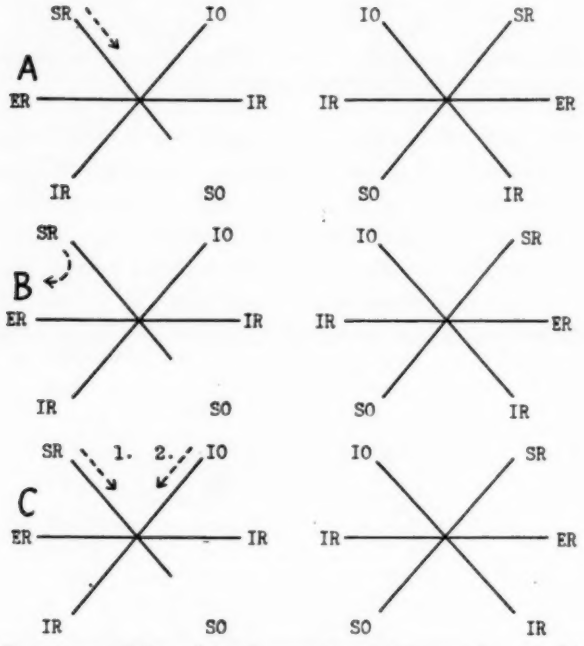


Fig. 5.—Tenotomy of homolateral superior rectus muscle. *A*, Müller's operation; *B*, Jackson's procedure; *C*, tenotomy of homolateral superior rectus and subsequent tenotomy of inferior oblique of same eye (Snell).

used, as Dunnington [5] pointed out, it cannot succeed completely. The superior rectus aids the normal superior oblique in intortion; therefore tenotomy will increase the existing extortion. Relief of the upward deviation will be partly accomplished, although the unopposed inferior oblique muscle, the remaining elevator, also will increase the extortion. Jackson [6] attempted to improve the operation by doing a partial tenotomy

4. Müller, L., cited by Dunnington.[5]

5. Dunnington, J. H.: Tenotomy on the Inferior Oblique, Tr. Am. Ophth. Soc. **27**:277, 1929.

of only the temporal fibers of the superior rectus. Later he [7] moved the insertion backward and outward (fig. 5 *B*), thus minimizing the elevating effect but at the same time increasing intortion; he reported 3 cases in which the paralysis improved with this method. Snell [8] reported a case in which treatment with tenotomy of the homolateral superior rectus was unsuccessful and he had to resort to subsequent tenotomy of the inferior oblique of the same eye (fig. 5 *C*). This procedure, of course, destroyed both elevators of the paralyzed eye, leaving the inferior rectus as the only vertically acting muscle.

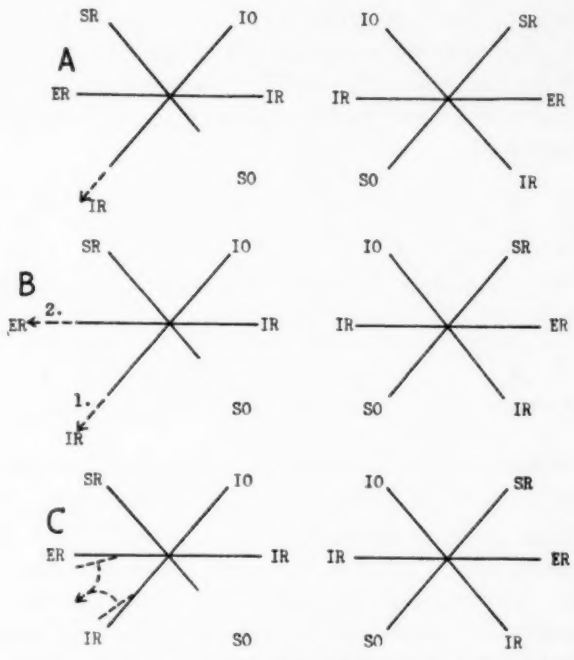


Fig. 6.—Advancement of homolateral inferior rectus muscle. *A*, Landolt's method; *B*, Bannister's modification of Landolt's method; *C*, Aurand's combined operation.

ADVANCEMENT OF INFERIOR RECTUS MUSCLE

Landolt [9] advised and practiced advancement of the homolateral inferior rectus for relief of paralysis of the superior oblique (fig. 6 *A*).

6. Jackson, E., in Wood, C. A.: American Encylopedia of Ophthalmology, Chicago, Cleveland Press, 1917, vol. 11, p. 8238.

7. Jackson, E.: Operation on the Tendon of the Superior Rectus Muscle for Paralysis of the Superior Oblique, Ophth. Rev. **22**:61, 1903.

8. Snell, A. C.: Injuries of the Superior Oblique Muscle: Report of a Case; Treatment, Arch. Ophth. **48**:111, 1919.

(Footnotes continued on next page)

Strengthening of the one remaining depressor was to compensate for the shortcomings of the underacting muscle. This method was reported by others as being successful. Of course, increasing the downward rotation by strengthening the inferior rectus would not help much in cases of inward rotation in which vertical diplopia is greatest, and would tend only to increase the already existing extortion, and probably also inward rotation. Bannister [10] in 1938, advised the use of this method and supplemented it by tucking or advancing the external rectus to overcome the homonomous diplopia due to inward rotation (fig. 6 *B*). Aurand [11] combined the effects of the two procedures by transplanting the inferior half of the external rectus and the external half of the inferior rectus to a point near the temporal part of the limbus and between the insertion of the two muscles (fig. 6 *C*). These operations cannot improve binocular vision down and to the opposite side, where it is needed most (figs. 2 *B* and 4 *B*).

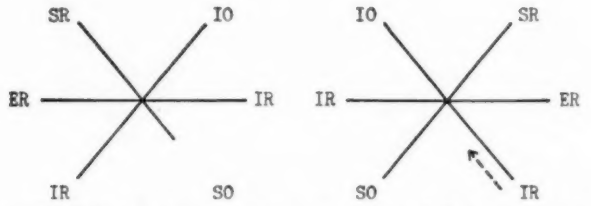


Fig. 7.—Wells's tenotomy of the contralateral inferior rectus muscle.

TENOTOMY OF INFERIOR RECTUS OF OPPOSITE EYE

In 1860 Wells [12] stated that tenotomy of the contralateral inferior rectus "affords complete compensation for the paralysis" of a superior oblique muscle (fig. 7). Von Graefe [13] also advocated the method, but Landolt [9] decried its use because of the limitation of downward gaze of the unparalyzed eye and the procedure was seldom used. Duane,[14] however, revised the method in 1896, saying:

" . . . when a muscle is too weak, the effect upon the movement of the two eyes is the same as if the associated antagonist in the other eye is too strong;

9. Landolt, E.: Anomalies of Motor Apparatus, in Norris, W. F., and Oliver, C. A.: System of Disease of the Eye, Philadelphia, J. B. Lippincott Company, 1900, vol. 4, p. 69.

10. Bannister, J. M.: Surgical Suggestions as to Individual Paralysis of the Oblique Ocular Muscles, Am. J. Ophth. **2**:537, 1928.

11. Aurand, cited by Wiener, M., and Alvis, B. Y.: Surgery of the Eye. Philadelphia, W. B. Saunders Company, 1939, p. 400.

12. Wells, cited by Dunnington.[5]

13. von Graefe, A., cited by Dunnington.[5]

14. Duane, A.: A New Classification of the Motor Anomalies of the Eye. Based upon Physiological Principles, Ann. Ophth. & Otol. **5**:969, 1896.

and if we tenotomize this antagonist we shall limit the movement of the sound eye in the same sense and to the same extent as that in which the movement of the affected eye is already limited, i.e., both eyes will move again equally and with each other, although the movement of neither will be normal.

Jameson,[15] in 1922, introduced his recession operation, and Bannister,[16] in 1925, presented his controlled tenotomy. Dunnington [5] pointed out that some form of "recession of the contralateral inferior rectus is the operation most commonly employed in paralysis of the superior oblique."

TENOTOMY OF HOMOLATERAL INFERIOR OBLIQUE MUSCLE

In 1885 Landolt [17] suggested tenotomizing the homolateral inferior oblique (fig. 8*A*), and the operation has been reported by Duane,[18] Posey,[19] White,[20] Dunnington,[5] Bielschowsky [1] and others. Snell [8] used the operation, as noted previously. It is indicated in the presence of

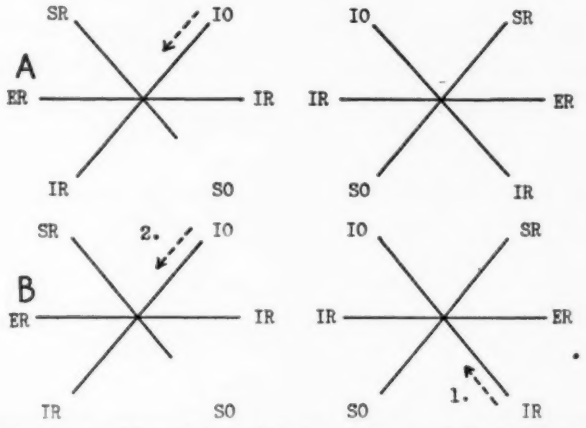


Fig. 8.—Tenotomy of homolateral inferior oblique. *A*, Landolt's procedure; *B*, combined recession of contralateral inferior rectus and subsequent tentomy or recession of homolateral inferior oblique (Bielschowsky's procedure).

paralysis of the superior oblique when the direct antagonist, the homolateral inferior oblique, has undergone contracture and produces marked overaction, or upshooting, of the eye on inward rotation (fig. 3).

15. Jameson, P. C.: Correction of Squint by Muscle Recession with Scleral Suturing, Arch. Ophth. **51**:421, 1922.

16. Bannister, J. M.: Problems Connected with the Surgical Treatment of Ocular Palsies, Tr. Am. Acad. Ophth. **30**:160, 1925.

17. Landolt, E., cited by Dunnington.[5]

18. Duane, A.: Isolated Paralyses of the Ocular Muscles, Arch. Ophth. **26**: 317, 1897.

19. Posey, W. C.: Congenital Squint, Tr. Sect. Ophth., A. M. A., 1907, p. 253.

20. White, J. W.: A Review of Twenty-Seven Years with the Obliques, Tr. Pacific Coast Oto-Ophth. Soc. **26**:112, 1941.

Division of the muscle minimizes the vertical imbalance when the eye is turned toward the nose. The operation has undergone many refinements in technic of tenotomy at both the origin and the insertion. White [21] and, after him Berens,[22] Guibor [23] and others have devised methods for receding and transplanting the distal end of the muscle.

As pointed out by Bielschowsky,[1] in the majority of cases diplopia in the lower field is due to imbalance between the paralytic superior oblique and the homolateral, antagonistic and overacting inferior oblique (fig. 3). Two operations are necessary, therefore, to permit binocular vision when the patient is looking straight ahead or to the opposite side, both above and below, namely, a recession of the contralateral inferior rectus and, later, a tenotomy or recession of the homolateral inferior oblique (fig. 8 *B*).

ELEVATION OF THE HYPOTROPIC EYE

When upshooting of the paralyzed eye occurs on looking to the opposite side, Spaeth [24] advocated elevation of the normal eye, which

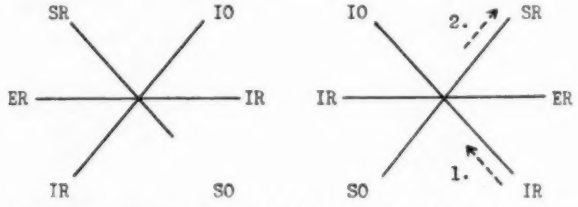


Fig. 9.—Recession of contralateral inferior rectus with advancement of contralateral superior rectus for elevation of hypotropic (normal) eye in upshooting of the paralyzed eye.

is in relative hypotropia. He suggested a wide recession of the contralateral inferior rectus followed or accompanied by an advancement of the contralateral superior rectus (fig. 9). While this tends to weaken depression in the nonparalyzed eye, it preserves the action of the inferior oblique, which, although overacting, is the only vertically acting muscle effective in the paralyzed eye on inward rotation.

Moreover, he prefers to raise the normal eye to the level of the higher, or paralyzed, eye, since when the eyes are up the patient can read more comfortably by tipping the head forward with the chin in; if the para-

21. White, J. W.: Surgery of the Inferior Oblique at or near the Insertion, Tr. Am. Ophth. Soc. **40**:118, 1942.

22. Berens, C., in discussion on White.[21]

23. Guibor, G. P.: Recession of Inferior Oblique Muscle from the External Rectus Approach, Am. J. Ophth. **27**:254, 1944.

24. Spaeth, E. B.: Principles and Practice of Ophthalmic Surgery, ed. 3, Philadelphia, Lea & Febiger, 1944, p. 233.

lyzed eye is brought down, reading is less comfortable, since when the eyes are down the head must be tipped back with the chin out.

ADVANCEMENT OF PARALYTIC SUPERIOR OBLIQUE MUSCLE

The superior oblique muscle with its reflected tendon is the most inaccessible of all the extraocular muscles because of its peculiar anatomic relations. However, advancement of its tendinous insertion has recently been perfected by Wheeler [25] (fig. 10) and is now used rather frequently

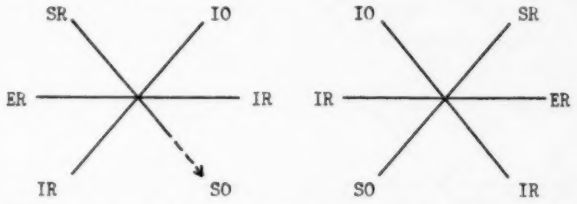


Fig. 10.—Wheeler's technic for advancement of a paralytic superior oblique muscle.

by White [26] and others, with good results. Peter [27] suggested tucking the superior oblique. Shortening of this muscle not only tends to strenghten its weakened function but confines the operative procedure to the particular field or fields involved and does not permit disturbance in fields not primarily affected by the isolated paralysis.

COMBINED OPERATIONS

A combination of three of the aforementioned methods is frequently employed, the procedures being carried out in the following order; namely, recession of the contralateral, synergistic inferior rectus, tenotomy of the homolateral, antagonistic inferior oblique and shortening of the paralytic superior oblique (fig. 11 *A*). This is the usual sequence followed by disciples of Duane, notably White [21] and Dunnington.[28] White [20] wrote that if the vertical deviation is marked,

> . . . it may be safer to tuck the superior oblique first, this to be followed by a tenotomy of the inferior oblique of the same eye, a recession of the inferior rectus of the opposite eye, or both, depending on the subsequent measurements [fig. 11 *B*].

This order is just the reverse of the preceding combination.

25. Wheeler, J. M.: Advancement of the Superior Oblique and Inferior Oblique Ocular Muscles, Tr. Am. Ophth. Soc. **32**:237, 1934.

26. White, J. W.: Personal communication to the author.

27. Peter, L. C.: Extra-Ocular Muscles, ed. 3, Philadelphia, Lea & Febiger, 1941, p. 354.

28. Dunnington, J. H.: Surgical Treatment of Strabismus, New York State J. Med. **38**:12, 1938.

By way of contrast, Gifford [29] weakened the homolateral inferior oblique if this was overacting, then did a recession of the opposite inferior rectus and, if the eye was still elevated, a recession of the homolateral superior rectus (fig. 12 *A*).

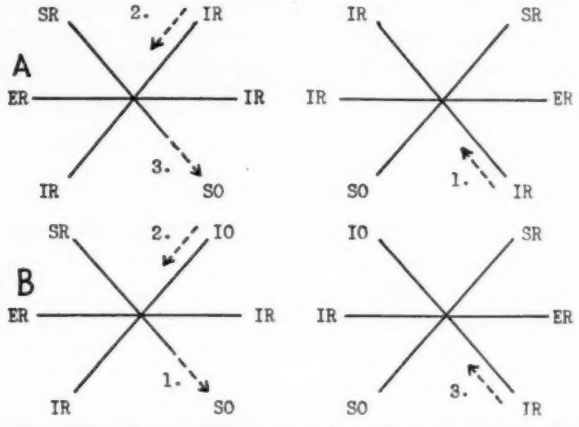


Fig. 11.—*A*, combined operation: recession of contralateral inferior rectus, tenotomy of homolateral inferior oblique and shortening of paralytic superior oblique; *B*, White's modification of preceding combined operation.

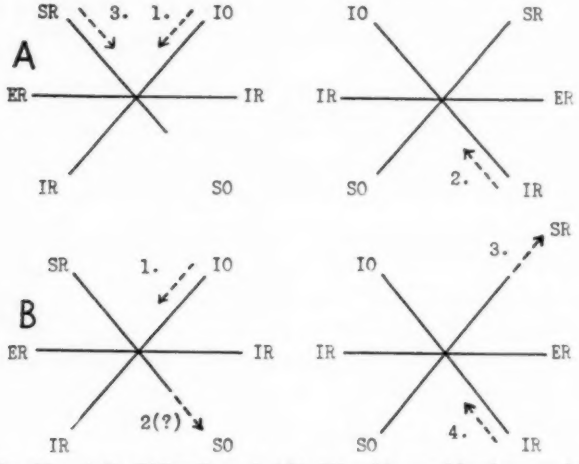


Fig. 12.—(*A*) Gifford's and (*B*) Worth's combined operation.

Worth,[30] following orthopedic principles, advocated lengthening of the overacting, and possibly contracted antagonistic, homolateral inferior

29. Gifford, S. R.: Results of Surgical Treatment of Paralysis of Superior Obliques and Superior Rectus Muscles, Arch. Ophth. **25**:761 (May) 1941.

30. Worth, C.: Worth's Squint or the Binocular Reflexes and the Treatment of Strabismus, ed. 7, edited by F. B. Chavasse, Philadelphia, P. Blakiston's Son & Co., 1938, p. 532.

oblique muscle. Theoretically, this should be followed by a shortening of the weakened superior oblique, but he apparently felt that this was not feasible. If necessary, the contralateral antagonist, the opposite superior rectus, is shortened, and, finally, recession of the contracted synergist, the opposite inferior rectus, is performed (fig. 12 *B*).

BILATERAL PARALYSIS OF SUPERIOR OBLIQUE MUSCLE

In cases of bilateral paralysis of the superior oblique White [26] varies his surgical procedure, depending on the patient's "choice of the fixating eye." If the patient fixes with the right eye on looking down and to the right (fig. 13 *A*) and fixes with the left eye on looking down and to the left (fig. 13 *B*), definite secondary contracture of the inferior oblique

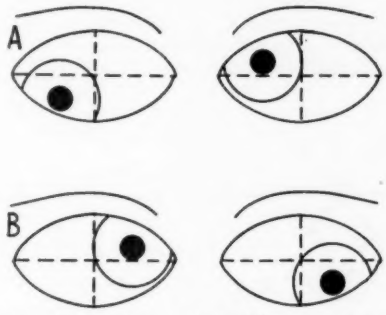


Fig. 13.—Bilateral paralysis of superior oblique muscle with secondary contracture of the inferior oblique muscle (*A*) when right eye fixes with patient looking down and to right and (*B*) when left eye fixes with patient looking down and to left.

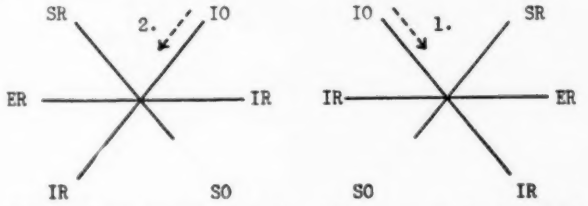


Fig. 14.—Bilateral tenotomy of inferior oblique muscle for bilateral paralysis of superior oblique muscle.

muscle is usually found. Bilateral tenotomy of the inferior oblique muscle is the preliminary procedure of choice (fig. 14). On the other hand, if the left eye fixes on looking down and to the right (fig. 15 *A*) and the right eye fixes on looking down and to the left (fig. 15 *B*), secondary deviation is usually due to the action of the respective yoke muscles, the inferior rectus muscles. In such cases a recession or tenotomy of each inferior rectus is indicated (fig. 16).

When both superior oblique muscles are paralyzed, the respective contralateral inferior rectus in each eye should be weakened, theoretically,

for the reasons previously mentioned. However, as Spaeth [24] pointed out, this would produce the complete loss of both depressors of each eye. Instead of this radical procedure, Jaensch [31] has recommended the con-

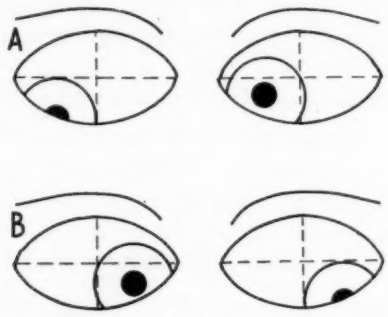


Fig. 15.—Secondary contracture of inferior rectus complicating bilateral paralysis of superior oblique (*A*) when left eye fixes on looking down and to right and (*B*) when right eye fixes on looking down and to left.

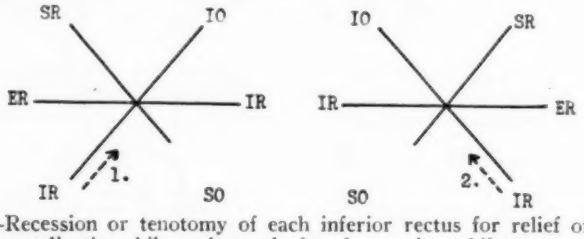


Fig. 16.—Recession or tenotomy of each inferior rectus for relief of secondary contracture complicating bilateral paralysis of superior oblique muscle.

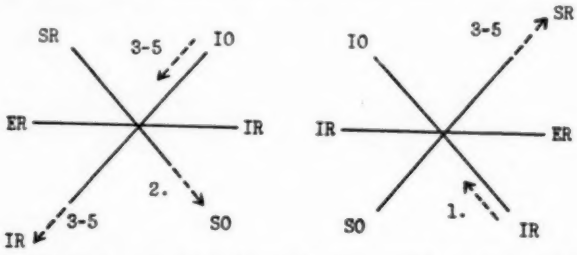


Fig. 17.—Preferred sequence of combined operations for paralysis of right superior oblique muscle.

servative equalization of all depressors, both right and left handed, so as to minimize paralytic cyclophoria and preserve single binocular vision in the lower fields as much as possible.

CONCLUSION

It must be realized that no one standard sequence of corrective measures can be advocated for all cases. The plan of attack must be

31. Jaensch, cited by Spaeth,[24] p. 236.

based on the measurements in the individual case. It is well to remember that if a choice is permitted weakening of a depressor muscle is undesirable; strengthening of a depressor or weakening of an elevator muscle is preferable, for there is greater need for binocular vision in the lower than in the upper fields. If there is marked overaction of the homolateral, antagonistic inferior oblique muscle, probably tenotomy of this muscle is desirable as the initial operation (fig. 8*A*). In the usual case of paralysis of the superior oblique muscle most surgeons apparently first do a recession of the contralateral inferior rectus and then attempt a shortening of the paralytic superior oblique, especially if the paralysis is of traumatic origin (fig. 17). Depending on measurements then obtained, these operations are supplemented by recession of the homolateral, overacting inferior oblique, advancement of the contralateral superior rectus or advancement of the homolateral inferior rectus. In cases of bilateral paralysis of the superior oblique equalization and preservation of the remaining depressors are advisable.

1930 Chestnut Street.

SURGICAL TREATMENT OF PRIMARY GLAUCOMA

C. S. O'BRIEN, M.D.
IOWA CITY

GLAUCOMA is a pathologic condition of the eye in which an elevation of intraocular pressure results in damage to or even complete loss of vision. It may be stated at this point that treatment should be guided by the damage to function and not, as is often the case, by the state of the intraocular pressure. It is not intended that one should ignore the tension, but it is urged that the greater emphasis be placed on the findings in the visual fields as a criterion for treatment. Every one is familiar with the fact that certain patients maintain a relatively high pressure with little or no loss of visual fields, while others continue to lose field even though the tension is apparently within normal limits.

The treatment of glaucoma is notoriously unsatisfactory. Neither medical nor surgical treatment can be entirely effective until the cause or causes of primary glaucoma are known. Medical treatment should be employed as long as there is no loss of visual fields and the tension can be controlled, but all too frequently one must resort to surgical measures. Surgical treatment should not be delayed too long, since better results follow operation in cases in which the condition is not too far advanced.

What can surgical intervention accomplish? It can increase the outflow of aqueous, and perhaps with diathermy decrease the formation of this fluid. It cannot restore the tension-regulating mechanism to normal, change the vitreous, alter the blood volume in the eye or as yet safely change the rate of aqueous formation.

Three common types of operative procedures are in use:

1. Operation for the relief of acute block of the anterior chamber angle, i. e., iridectomy, in cases of acute narrow angle glaucoma.

2. Operation which opens a new intraocular drainage channel, i. e., cyclodialysis. This operation is most successful in cases of early chronic wide angle glaucoma, the chronic narrow angle type perhaps and the secondary type which follows cataract extraction.

From the Department of Ophthalmology, State University of Iowa College of Medicine.

Read at a meeting of the New York Academy of Medicine, Section of Ophthalmology, Dec. 17, 1945. The discussion on this paper was published in the May 1946 issue of the ARCHIVES, pages 582-586.

3. Operations which open an extraocular drainage channel, i. e., the so-called filtering operations, such as iridencleisis, iridotasis, anterior sclerectoiridectomy and corneoscleral trephination. These operations are indicated for all types of primary glaucoma except the early acute narrow angle type, the early chronic wide angle type and, at times, chronic narrow angle glaucoma.

In every case 1 per cent physostigmine salicylate is administered to each eye at least one-half hour before operation. Any operation for glaucoma may be performed with a local anesthetic. Even the iridectomy for acute narrow angle glaucoma may be made with little pain if ¼ to ⅜ grain (16 to 24 mg.) of morphine sulfate is given before operation and time is allowed for the retrobulbar injection to act. Cocaine is contraindicated because of its mydriatic action, but 0.5 per cent tetracaine hydrochloride may be substituted for instillation. Then a subconjunctival injection of 2 per cent procaine hydrochloride without epinephrine, followed by a retrobulbar injection of 2 per cent procaine hydrochloride with epinephrine hydrochloride (1:20,000) completes the anesthesia.

IRIDECTOMY

This operation is indicated in cases of early acute narrow angle glaucoma. It is usually successful if the tension can be reduced to normal with miotics or if the acute attack is of not more than three days' duration. If the anterior chamber angle is found to be filled with synechias on visualization with the gonioscope, iridectomy is contraindicated, and one should perform a filtering operation. It is well to reduce the congestion in such an eye before operation if possible.

A keratome incision is contraindicated in iridectomy because the incision is situated too far forward. A shelf of cornea projects in front of the chamber angle and makes it practically impossible to perform a basal iridectomy.

An incision with the Graefe knife is better but is difficult. Fixation must be firm. The puncture begins at 11 o'clock at a point 2 to 3 mm. back of the limbus, and, with the blade parallel to and almost against the iris, the knife is carried across the upper portion of the chamber. At 1 o'clock the point of the knife is passed into the chamber angle and the counterpuncture made. This is a stab incision until the knife point emerges from the sclera and conjunctiva on the side of the counterpuncture. Then, with the blade in the same flat position, the knife is swept upward through the sclera and the conjunctiva. The disadvantages of this incision are its technical difficulties, the profuse bleeding, the rapid loss of aqueous and the tendency of the iris to prolapse at once into the incision, thus making it difficult or impossible to perform a peripheral basal iridectomy.

The best operation for acute narrow angle glaucoma is the so-called iridectomy ab externo; it is especially good with an extremely shallow anterior chamber. With this technic, the aqueous escapes slowly and the iris does not prolapse into the wound; an iridectomy of the peripheral basal type is easily made, and the operation is not technically difficult. Formerly, some trouble was encountered with fixation, but since scleral fixation sutures have been in use the procedure is simple. After an injection of 2 per cent procaine hydrochloride is made between Tenon's capsule and the sclera, a 5 mm. flap of conjunctiva and Tenon's capsule is dissected downward from above the upper portion of the limbus. A fixation suture is then placed by passing a 0000 braided silk suture through the superficial fibers of the sclera 5 mm. back of the limbus, cutting the two ends of the suture relatively short and grasping them close to the sclera with a small hemostat. Such an arrangement gives excellent and easily controlled fixation. Remembering that the anterior chamber angle is 1.5 mm. back of the limbus, an incision 5 to 6 mm. in length is made over this area in a direction parallel to the curvature of the cornea. The incision is made easily and safely with a sclerotome, a Graefe knife or a keratome, with preference for the double-edged sclerotome. An ordinary incision made halfway or more through the sclera is followed by scratching or picking through this coat along the entire length of the incision. One must be careful not to injure the underlying structures. The incision is followed by a peripheral basal iridectomy and replacement of the conjunctival flap. Sutures complete the operation.

CYCLODIALYSIS

This operation has fallen somewhat into disrepute, probably as a result of improper technic followed by a large percentage of failures. It is believed that an insufficient area of the attachment of the ciliary body has been ruptured in many cases and that if almost half the circumference is dialyzed the results are much better.

The operation is indicated in cases of early, and perhaps late, chronic wide angle glaucoma and of the secondary rise of tension following cataract extraction. Furthermore, it is the operation of choice in cases with only a slight elevation of tension, in those with very small visual fields and in many cases in which an external filtering operation has failed to reduce the tension to a normal level.

It is well to make a gonioscopic examination of the chamber angle before operation. This may help one to avoid dense anterior peripheral synechias or large blood vessels in the angle.

Technically the procedure is not difficult, especially if a scleral fixation suture is used. The operation may be done above or below the horizontal meridian, but it is well to avoid the horizontal area in order

to keep away from the long ciliary arteries. If the operation is made below the horizontal meridian, the conjunctiva is incised 5 to 6 mm. back of the limbus at a point immediately lateral to the inferior rectus muscle.

A scleral fixation suture of 0000 silk is placed just anterior to the point chosen for the incision. The suture is cut short and grasped near the sclera with a small hemostat. With this suture the globe is well controlled, and if the handle of the hemostat is depressed toward the cornea the anterior lip of the scleral wound is elevated and passage of the spatula is facilitated.

A "scratch and pick" incision, as described for iridectomy ab externo, is made approximately 5 mm. behind the limbus and just back of the fixation suture. This incision should be about 5 mm. in length in order to allow some play with the spatula.

A blunt spatula is introduced and care exercised to hug the inner part of the sclera as its tip is carried forward into the anterior chamber angle.

The attachment of the ciliary body to the scleral spur is ruptured by pushing in this area, rather than by sweeping. It is well to keep the spatula out of the anterior chamber as much as possible, since the corneal endothelium and Descemet's membrane are easily damaged. Almost one-half the circumference of the attachment of the ciliary body is dialyzed.

Bleeding, if excessive, may be controlled in part by holding a moist absorbent applicator against the scleral wound, even during the dialysis. Also, the spatula and applicator are left in position as long as bleeding continues.

SCLERECTOIRIDECTOMY (LAGRANGE)

Of the external filtering operations, the Lagrange type has been successful most often in this clinic.

The operation is reasonably easy to perform and apparently is followed rarely by cataract. Furthermore, one can combine with it an iris inclusion if a portion of this structure is pulled forward into the scleral opening.

The operation is begun with injection of 2 per cent procaine hydrochloride under Tenon's capsule above the upper portion of the limbus. With dissection thus facilitated, a large, thick flap is made and carried over onto the cornea, as is usually done. Next, a scleral fixation suture, as previously described, is placed in the 11 or 1 o'clock meridian about 5 mm. back of the limbus and grasped with a small hemostat. Then a scratch incision approximately 6 mm. long is made through the outer coat of the globe 1.5 mm. back of the limbus. After completion of the incision, a bite is taken out of the anterior flap of sclera and cornea with

a Holth punch. A peripheral basal iridectomy is done, and as a final step the conjunctival flap is sutured.

A variation of the operation, i. e., combination with an iris inclusion, is made by grasping the iris midway between the pupillary and the cilary margin, making an upward snip from a point just below the iris forceps and then laying the flap in the scleral opening.

After any filtering operation for glaucoma daily massage helps to establish and maintain filtration. This massage is begun on the day following operation and is continued as long as necessary.

State University of Iowa College of Medicine.

RELAPSING AND CHRONIC OCULAR LESIONS

Following Mustard Gas (Dichloroethyl Sulfide) Burns

R. O. SCHOLZ, M.D.
AND
A. C. WOODS, M.D.
BALTIMORE

RELAPSING and chronic ocular lesions following mustard gas (dichloroethyl sulfide) burns are reported infrequently in the open literature. There is but 1 such case reported in the American literature [1] and none in the records of the United States Veterans Hospitals.[2] Two hundred and forty-three case reports have been found; 136 give sufficient data for review. Of the cases collected in this paper, 40 are from the open European literature,[3] 1 from the American literature,

---

From the Wilmer Ophthalmological Institute of the Johns Hopkins Hospital.

The work described in this paper was done under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and the Wilmer Ophthalmological Institute of the Johns Hopkins Hospital and University.

1. McKellar, J. H.: Recurring Kerato-Conjunctivitis Following Exposure to Dichloroethylsulphid, Am. J. Ophth. **3**:309-210, 1920.

2. Winternitz, M. C.: Personal communication to the authors.

3. (*a*) Bickerton, R. E.: New Cases of War Blindness Due to Mustard Gas, Brit. M. J. **2**:769-770, 1934. (*b*) Bonnet, P.: Ectasies vasculaires de la conjonctive, reliquat d'une brûlure par ypérite, Bull. Soc. d'opht. de Paris **61**:407-409, 1939; (*c*) Dystrophie de la cornée avec ulcère torpide, manifestation tardive de l'atteinte par ypérite, ibid. **51**:432-433, 1939. (*d*) de Courcy, T. L.: Recurring Keratitis from Mustard Gas Shell, Tr. Ophth. Soc. U. Kingdom **52**:558-559, 1932. (*e*) Dor, L., and Fouassier: Suite éloignées des brûlures conjonctivales per l'ypérite, Clin. opht. **26**:183-191, 1932. (*f*) Fairclough, W. A.: Gas Keratitis, Australian & New Zealand J. Surg. **7**:163-166, 1937. (*g*) Genet, L.: Ypérite, ischémie conjonctivale, ulcère cornéen tradif, Bull. Soc. d'opht. de Paris **49**:409-412, 1937. (*h*) Heckford, F.: Delayed Corneal Ulceration Following Mustard Gas Burns, Proc. Roy. Soc. Med. **30**:949, 1937. (*i*) Jacqueau, A., and Bujadoux, A.: Infection aiguë et spontanée des deux globes oculaires, à deux ans d'intervale, chez un ancien ypérité, Bull Soc. franç. d'opht. **38**:370-380, 1925. (*j*) Pesme, P.: Fistula de la cornée consecutive à brûlure par l'ypérite, Arch. d'opht. **41**:278-283, 1924. (*k*) Moore, R. F., and Heckford, F.: Delayed Corneal Ulceration from Mustard Gas, Brit. M. J. **1**:497-498, 1929. (*l*) Neame, H.: Late Result After Mustard-Gas Burn of the Eye, Proc. Roy. Soc. Med. **22**:25-26, 1928. (*m*) Parlange, J. A.: Les séquelles oculaires des gaz de combat, Arch. d'opht. **46**:87-119, 1929. (*n*) Ridley, H.: Mustard Gas Keratitis, Proc. Roy. Soc. Med. **29**:962-963, 1936. (*o*) Rohrschneider, W.: Spätschädigung der Augen nach Gelbkreuzgas-

(Footnote continued on next page)

9 from the duplicate records of the Evergreen School for the Blind in Maryland (1918 to 1924), an institution to which all of the United States Army blind of World War I were sent after the close of hostilities, and 2 were submitted from private practice.[4] Recently Mann [5] analyzed 84 cases from one London hospital.

The 107 cases not included in this review are mentioned only briefly in the literature,[6] and the data are insufficient for analysis.

ANALYSIS OF CASE REPORTS

The original records of the patients are usually not accessible; the few which are available are incomplete because of combat conditions. The available data for the cases reviewed are summarized in table 1.

The cases may be roughly divided into three groups: The first group consists of the 24 cases, 16 summarized in table 1 and 8 mentioned by Mann, in which the course was a chronic one, with exacerbations and remissions. The second group consists of 96 cases, 20 summarized in table 1 and 76 studied by Mann, in which there were recurrences from five months to twenty-six years after the original lesion had apparently healed. The third group comprises 16 cases (table 1) in which the available data do not permit classification.

Mann [5] saw no case of delayed keratitis in which the initial ocular symptoms lasted less than six weeks. In the literature reviewed here, the exact nature and extent of the original burn could not be determined, but from the reports in which sufficient detail was given it was noted that the initial lesions were severe and hospitalization was prolonged.

From the available clinical data, no essential difference could be found between the ocular lesions in the cases of chronic and those of the recurring type; so they will be described together.

The usual presenting symptoms were severe photophobia and lacrimation with frequent diminished visual acuity. On examination, the conjunctiva was found to be congested except in the intrapalpebral fissure, where, adjacent to the limbus, there were porcelain white

---

Vergiftung, Klin. Monatsbl. f. Augenh. **99**:447-455, 1937. (*p*) Šrytr, F.: Varätzung mit Yperite, Oftal. sborn. **5**:215-222, 1930; (*q*) Zentralbl. f. d. ges. Ophth. **24**: 334-335, 1931. (*r*) Sourdille, G. P.: Troubles cornéens et lésions vasculaires du limbe chez un ypérité, Bull. Soc. d'opht. de Paris **48**:799-801, 1936. (*s*) Weill, G.: Ulcères tradifs de la cornée chez un ancien ypérité, ibid. **51**:281-282, 1939. (*t*) Zettl, W.: Zur Symptomatologie und Therapie der Spätschädigungen des Auges durch Gelbkreuzgas, Klin. Monatsbl. f. Augenh. **104**:217-222, 1940.

4. (*a*) Burke, J. W.: Personal communication to the authors. (*b*) Friedenwald, J. S.: Personal communication to the authors.

5. Mann, I.: Report on a Follow-up Investigation of Eighty-Four Cases of Delayed Mustard Gas Keratitis, personal communication to the authors.

6. Ratnaker, R. P.: A Case of Nystagmus Caused by Mustard Gas, Lancet **1**:423-424, 1919. Parlange.[8m]

ischemic areas surrounded by dilated irregular veins. In 6 of the reported cases only the conjunctiva was involved.[3m]

In the majority of cases, 74 in Mann's series and 44 of the 52 cases summarized in table 1, the corneal lesions ranged from mild superficial keratitis to a corneal fistula[3j] and perforated corneal ulcers.[7]

The ulcers were described as being of various depths, sizes and locations but usually occurred in the palpebral fissure at the limbus. The margins of the ulcers were raised and irregular. The tissue immediately surrounding the ulcer was necrotic. In some cases calcification took place. The clinical course of these ulcers was one of frequent remissions and exacerbations. Secondary iritis occurred in 5 cases and glaucoma in 2 cases. The distribution of the complicating lesions in the various groups is shown in table 2.

Some of the patients had fair visual acuity following the healing of the initial burn and lost vision completely only as the result of subsequent attacks.

Excluding the cases of mild conjunctival involvement reported by Parlange,[3m] in which there was practically no loss of visual acuity, average loss of vision in the remaining cases in table 1 was approximately 88 per cent. This visual disability presents a medicolegal problem. Unless the recurrent nature of mustard gas burns is understood, the examining physician may ascribe the ulcers to another cause, and the patient may be thus deprived of his disability compensation.

Until the recent successful use of contact lenses to treat patients with such lesions[8] therapy on the whole has been unsatisfactory. Local treatment with diathermy, antiseptic and anesthetic ointments and atropine has been most frequently given. Nonspecific protein therapy has been tried, without success.

Enucleation was necessary in 4 cases. A Saemisch section was tried in 1 case, without success.[3l] Closure of the corneal fistula in Pesme's case was accomplished by electrolysis. Curettage of the corneal ulcer was successfully performed in some of the cases reported in table 1[9] and in some of Mann's cases.

Tarsorrhaphy was tried in 4 of the cases tabulated here but was successful in only 1. This treatment was also successful in Duke-Elder's cases, which are not reviewed here, and was advised by Phillips[8a] and Mann[5] in their reviews. Bickerton,[3a] on the other hand, advised against this treatment.

---

7. Bickerton.[3a] Jacqueau and Bujadoux.[3l]

8. (*a*) Phillips, T. J., in Discussion on Gas Injuries to the Eye, Proc. Roy. Soc. Med. **33**:229-232, 1940; (*b*) personal communication to the authors. (*c*) Duke-Elder, W. S.: Text-Book of Ophthalmology, St. Louis, C. V. Mosby Company, 1938, vol. 2.

9. Friedenwald.[4b] Moore and Heckford.[3k]

TABLE 1.—*Summary of Case Histories in Present Series*

Author	Case Number	Source of Material	Salient Clinical Information	Final Visual Acuity
			A. Chronic Lesions	
Bickerton [3e]	1	Literature	Gassed in 1918; 9 mo. in hospital thereafter; steady visual loss. Marked retinal degeneration and pigmentation noted in 1935	R. E.: 1/200 L. E.: ½/200
	2	Literature	Gassed in 1918; 4 mo. in hospital; eyes have "troubled" since. L. E. broke down in 1929 and again in 1933; R. E. ulcerated in 1933; both eyes treated with tarsorrhaphy; ulcerations continued	R. E.: 1/60 L. E.: Loss
	3	Literature	Patient gassed in 1917; 7 mo. in hospital; under treatment since. 1934: R. E. corneal nebula irritis; L. E.: intense photophobia, corneal nebula	R. E.: 3/60 L. E.: 1/200
	4	Literature	Gassed in 1918; eyes never recovered. 1934: bilateral corneal ulceration; tarsorrhaphy in left eye. Recurrences of ulceration every six weeks	R. E.: 2/60 L. E.: Loss
	5	Literature	Gassed in 1915; 6 mo. in hospital. Both corneas badly burned; patient under treatment since; vision still deteriorating	R. E.: ? Light perception L. E.: 1/60
Parlange [3m]	1	Literature	Gassed in 1918; continuous conjunctival irritation to 1928; no corneal involvement	R. E.: 20/20 L. E.: 20/20
	2	Literature	Gassed in 1918; chronic conjunctival infection with exacerbations; small corneal pannus	R. E.: 20/30 L. E.: 20/30
	3	Literature	Gassed in 1918; chronic conjunctival irritation until 1926; no corneal involvement	R. E.: 20/30 L. E.: 20/30
	4	Literature	Gassed in 1918; chronic conjunctival injection with signs of irritation at times	R. E.: 20/20 L. E.: 20/20
	5	Literature	Gassed twice in 1918; chronic conjunctivitis, particularly when fatigued; no corneal involvement	R. E.: 20/20 L. E.: 20/20
Woods	1	Evergreen School for the Blind	Gassed in 1918; slight impairment of vision with subsequent chronic inflammation. 1920: R. E.: follicular conjunctivitis and corneal nebula; L. E.: violent deep purple congestion of conjunctiva, thickening of lids, corneal nebula	R. E.: 1/60 L. E.: Hand movements
	2	Evergreen School for the Blind	Gassed in 1918; sight failed steadily thereafter. 1920: R. E.: anophthalmos; L. E.: keratouveitis with secondary glaucoma	R. E.: 0 L. E.: 0
	3	Evergreen School for the Blind	Gassed in 1918; L. E. weak thereafter and lacrimating, with subsequent complete blindness; enucleated	R. E.: 20/30 L. E.: 0

	4	Evergreen School for the Blind	Gassed in 1918; continued failure of vision. R. E.: chronic congestive glaucoma with acute exacerbation; enucleation. L. E.: old amblyopia ex anopsia	R. E.: 0 L. E.: 2/30
	5	Evergreen School for the Blind	Gassed in 1918; continual symptoms in warm weather; bilateral corneal ulceration in 1919. 1920: R. E.: deep conjunctival congestion with follicles, corneal nebulas; L. E.: opaque cornea, superficial clouding, vascularization	R. E.: Hand movements L. E.: 2/60
	6	Evergreen School for the Blind	Gassed in 1915; recurrent conjunctivitis thereafter. 1920: R. E.: conjunctival congestion with tendency to dry folliculosis, cornea practically clear, organized exudate on anterior capsule of lens; L. E.: fibrous tag across pupil; exudate over anterior capsule. Other evidence of old iritis	R. E.: 2/60 L. E.: 2/30
			B. Recurrent Lesions	
Bonnet [3b, c]	1	Literature	Gassed in 1918; severe conjunctival burns; vision lowered 2 yr. 1937; R. E.: bulbous keratitis; L. E.: serpiginous ulcer of cornea and hypopyon	R. E.: 0 L. E.: 0
Burke [4a]	1	Private practice	Gassed in 1917; invalided for 6 mo. 1937: corneal ulcer in L. E. 1940: corneal ulcer in R. E.	R. E.: 18/20 L. E.: 20/50
Fairclough [3f]	1	Literature	Gassed in 1917; corneal nebulas present 1 mo. after burn; patient returned to service. 1930: shallow ulcer of cornea with photophobia and lacrimation. 1936: R. E.: irritated, corneal sensitivity diminished; L. E.: chronically congested conjunctival vessels	R. E.: Not given L. E.: Not given
	2	Literature	Patient gassed in 1918; hospitalized 63 days with keratoconjunctivitis; condition quiet until 1924; vision then 6/36 (O. U.). 1924: bilateral conjunctivitis, nebulous corneas with calcereous deposits. Evidence of old iritis	R. E.: 6/60 L. E.: 6/60
	3	Literature	Gassed in 1917; severe conjunctivitis, lacrimation and photophobia. 1920: patient well, with 6/5 vision (O. U.). 1933: recurrence in R. E. 1936: L. E.: blind, painful; enucleated	R. E.: Not given L. E.: 0
Genet [3g]	1	Literature	Patient gassed in 1916, well until 1931, when corneal ulcers appeared; several remissions and exacerbations. 1936: R. E.: injected vessels and corneal leukoma; L. E.: intense congestion except for ischemic area and small epithelial corneal ulcer, which did not heal within 1 yr.	R. E.: Not given L. E.: Not given
Heckford [3h]	1	Literature	Apparent early recovery from first burn. 1932; recurrence with porcelain white appearance of conjunctiva, injected vessels, loss of corneal substance. Diminished corneal sensation over scarred areas	R. E.: 6/18 L. E.: 6/24
Jacqueau and Bujadoux [3i]	1	Literature	Gassed in 1918; vision decreased for 6 mo., then slowly improved. 1922: R. E.: sudden development of corneal ulcer with subsequent panophthalmitis and enucleation; L. E.: corneal ulcer 1 mo. later with enophthalmitis	R. E.: 1/10 L. E.: 1/13

TABLE 1.—*Summary of Case Histories in Present Series—Continued*

Author	Case Number	Source of Material	Salient Clinical Information	Final Visual Acuity
McKellar [1]	1	Literature	Gassed in 1918; inflammation lasted 6 wk. 1919: fourth recurrent attack of corneal ulceration; R. E.: conjunctivitis; L. E.: normal in 1 mo.	R. E.: Not given L. E.: Not given
Parlange [3m]	1	Literature	Patient gassed in 1918, well to 1921; then recurrent conjunctivitis; old corneal scars	L. E.: 20/30 R. E.: 20/30
	2	Literature	Gassed in 1918 (probably by mustard gas); recurrent conjunctivitis; in 1928 cicatricial keratitis	R. E.: 20/100 L. E.: Not given
	3	Literature	Gassed in 1917; conjunctiva injected at various times. 1928; infected conjunctiva and small corneal opacity	R. E.: 20/20 L. E.: 20/20
	4	Literature	Gassed in 1918. 1928: conjunctivitis; small pannus	R. E.: 20/15 L. E.: 20/15
	5	Literature	Gassed in 1918 (probably lacrimal and mustard gas); repeated attacks of conjunctivitis	R. E.: 20/30 L. E.: 20/30
Ridley [3n]	1	Literature	Patient gassed in 1918; blind for 10 days; vision normal in 1919 and 1921. 1936: recent diminution of vision; bilateral corneal opacities in palpebral fissures; corneal fissures reduced	R. E.: 6/60 L. E.: 6/60 L. E.: 6/60
Rohrschneider [3o]	1	Literature	Gassed in 1918; no definite evidence of corneal damage; complete recovery. 1933: bilateral degenerative keratitis	R. E.: 10/200 L. E.: 30/200
Sourdille [3r]	1	Literature	Gassed in 1918. 1933: severe conjunctival lesions. 1936: R. E.: keratitis; L. E.: superficial keratitis	R. E.: 20/200 L. E.: Not given
Weill [3s]	1	Literature	Gassed in 1918; no trouble until 1937; then marginal corneal ulcers without pain or injection	R. E.: Not given L. E.: Not given
Woods	1	Evergreen School for the Blind	Gassed at drill in 1919 (kind of gas?); vision improving since. 1921: R. E.: chronic conjunctivitis. L. E.: old iritis and immature cataract	R. E.: 2/60 L. E.: 2/30
Zettl [3t]	1	Literature	Gassed in 1918; corneal burn; decreased visual acuity. No complaints to 1924; then recurrence of irritation. 1935: corneal ulcer. 1939: corneal ulcer in R. E.; with Denig transplant vision improved from counting fingers at 1 ft. to 6/200	R. E.: 6/200 L. E.: 20/20
			C. Cases Not Classified	
Bickerton [3a]	1	Literature	Gassed in 1918; corneal ulcers and nebulas in both eyes. 1934: recurrence of inflammation and ulceration	R. E.: 4/60 L. E.: 1/60
	2	Literature	Gassed in 1918. 1934: R. E.: perforated corneal ulcer; L. E.: lower half of cornea opaque. Evidence of old iritis	R. E.: 0 L. E.: Light perception

Bonnet [3b, e]	1	Literature	Gassed in 1917; no symptoms, even in 1937; vascular ectasis of conjunctiva. Biopsy of conjunctiva revealed dilated vessels and fibrous tissue	R. E.: Not given L. E.: Not given
Dor and Fouassier [3e]	1	Literature	Gassed in 1918; treatment for leukoma of both corneas with ulcers for 14 mo.	R. E.: Not given L. E.: Not given
	2	Literature	Gassed in 1918; 3 mo. rest required; much photophobia and lacrimation	R. E.: Not given L. E.: Not given
de Courcy [3d]	1	Literature	Liquid splash burn in 1917; keratitis 6 mo.; diminished vision in R. E. 1925: R. E.: keratitis "flared up" for over a year, partial tarsorrhaphy; L. E.: keratitis flared up, both corneas hyposensitive. 1932: condition in R. E. again flared up; crystals in both corneas	R. E.: 6/60 L. E.: 6/9
Fisher	1	Literature	Patient seen in 1928, with bilateral hypopyon ulcers; condition helped by tarsorrhaphy	R. E.: Not given L. E.: Not given
Friedenwald [4b]	1	Private practice	Gassed in 1918; right eye severely burned. 1929: recurrent ulcers; R. E. helped by curettage; L. E. irritated but not ulcerated	R. E.: Not given
Moore and Heckford [3k]	1	Literature	Gassed in 1917. 1928: deep, gutter-like excoriation of cornea; small ulcers at limbus	R. E.: Not given L. E.: Not given
	2	Literature	Gassed in 1917; 1922: ulceration of L. E., with formation of nebulas; recurrence. 1928: corneal ulcer curetted, slowly healed over in 7 mo.	R. E.: Not given L. E.: Not given
Neame [3l]	1	Literature	Gassed in 1918, 3 mo. in hospital. 1928: R. E.: pallor around cornea, engorgement of vessels peripheral to this; L. E.: hypopyon ulcer; Saemisch section; eye blind	R. E.: Not given L. E.: 0
Parlange [3m]	1	Literature	Gassed in 1918. 1928: dilated vessels and corneal anesthesia	R. E.: 20/20 L. E.: 20/20
Pesme [3j]	1	Literature	Gassed in 1918. 1924: L. E.: vision decreased, owing to keratitis; subsequent development of fistula; which was closed with electrolysis needle; R. E.: healed keratitis	R. E.: 4/10 L. E.: Not given
Srytr [3p]	1	Literature	Splash burn on cheek in 1918; immediate neutralization: 5 mo. later R. E. showed irritation of lower cornea with deep vascularization and hemorrhage	R. E.: Not given L. E.: Not given
Woods	1	Evergreen School for the Blind	Gassed twice in 1918; blind 2 yr. after; 1921: recurrence of great conjunctival congestion, lacrimation and photophobia	R. E.: Counting fingers L. E.: Counting fingers
	2	Evergreen School for the Blind	Gassed in 1918; poor vision since. 1921; conjunctival congestion with tendency to dry folliculosis, organized exudate on anterior capsule of both lenses. Corneas practically clear	R. E.: 2/60 L. E.: 2/30

Ida Mann, in her excellent review in 1944,[5] reported the most beneficial results to date from the use of contact glasses. She stated that "the history of a long interval, followed by repeated ulcers and fluctuating but slowly deteriorating visual acuity, which is relieved by wearing contact glasses, is typical of roughly 46 per cent of the cases." In all but 2 of her cases conspicuous improvement in visual acuity followed the use of contact lenses. Because of this notable increase in visual acuity, together with the relative insensitivity of their corneas, the patients had good tolerance for the contact glasses, almost half wearing the lenses throughout the working day.

Phillips, likewise, had remarkable results not only in healing recurrent ulcers but also in improving vision with the use of contact glasses.

TABLE 2.—*Summary of Late Complications Found in Cases of Relapsing Mustard Gas Lesions of the Eyes*

Complications	Chronic Lesions (24)	Recurrent Lesions (96)	Cases Not Classified (16)
Corneal ulcers	5	14 74 (Mann)	10
Conjunctivitis			
Chronic	5	6	2
Follicular	2	..	1
Iritis	3	..	2
Cataract	..	1	..
Glaucoma			
Acute	1	..	..
Chronic	1	..	..
Retinitis	1	..	..
Choroiditis			
Insufficient data	9	..	..

The use of corneal transplants in treatment of these lesions has not been reported but may be of value. It is also suggested that the scars may be cleared by the injection of an enzyme preparation which will strongly hydrolyze hyaluronate and chondroitin sulfate [10]

ETIOLOGIC FACTORS

The etiologic factors most applicable to the production of relapsing mustard gas injuries, as taken from the review of Hughes [11] and from the more recent literature, are: (1) tissue sensitivity, (2) destruction of the mucous glands, (3) corneal anesthesia, (4) vascular abnormalities, (5) cholesterol crystals and (6) loosening of the corneal epithelium.

10. Meyer, K., and others: The Effects of Intracorneal Injection of Hyaluronic Acid and Its Monosulfuric Acid Ester; The Action of Testicular Enzyme Preparations on Corneal Opacities, personal communications to the authors.

11. Hughes, W. F., Jr.: Mustard Gas Injuries to the Eyes, Arch. Ophth. **27**:582-601 (March) 1942.

Tissue Sensitivity.—Sollmann,[12] after experiments on human beings, concluded that "healed mustard burns are over-susceptible to injury, mechanical or chemical, and therefore incidentally to mustard." He expressed the belief that uninjured skin does not become sensitive to mustard gas. As the patients in the present series were not again exposed to this gas, the recurrences might conceivably have been due to autosensitivity to altered corneal proteins. That specific antigens may be obtained from serum treated with mustard gas was shown by Berenblum and Wormall.[13]

Destruction of Mucous Glands.—Bickerton [3a] suggested that the changes in the tissue resulted from lack of a lubricating substance after destruction of the mucus-secreting glands of the conjunctiva. Warthin and Weller,[14] in their studies on the pathologic changes in rabbit eyes burned with mustard gas, showed that there is involvement of the conjunctival epithelium in which the mucous glands are located but that the epithelium is rapidly regenerated. From the clinical data no evidence of lack of lubricating secretions is found, and the unexposed portions of the conjunctiva could be expected to furnish their normal contribution of mucus.

Corneal Anesthesia.—The cornea was reported to be anesthetic in many of the cases, and Fairclough [3f] mentioned this as characteristic of recurrent mustard gas lesions. If the recurrent or relapsing lesion is caused by a mechanism similar to that of neuroparalytic keratitis, it is remarkable that it does not occur more frequently in conditions in which hypesthesia of the cornea is also present.

Vascular Abnormalities.—The ischemic areas in the conjunctiva, the "marbled veins" and the necrotic chronic ulcers suggest absence of adequate blood supply as a cause. While the conjunctival vessels normally may be responsible for some part of the nutritive supply of the cornea, the major supply of metabolites normally comes from the aqueous and from oxygen of the outside air.

Cholesterol Crystals.—Mann and Pullinger [15] suggested that the recurrent lesions may be caused by cholesterol crystals working their way to the surface and causing ulceration of the epithelium. They

12. Sollmann, T.: Dichlorethyl Sulphid ("Mustard Gas"), J. Pharmacol. & Exper. Therap. **12**:303-321, 1919.

13. Berenblum, I., and Wormall, A.: The Immunological Properties of Proteins Treated with $\beta\ \beta^1$-Dichlorodiethylsulphide (Mustard Gas) and $\beta\ \beta^1$-Dichlorodiethylsulphone, Biochem. J. **33**:75-80, 1939.

14. Warthin, A. S., and others: The Ocular Lesions Produced by Dichlorethylsulphide, J. Lab. & Clin. Med. **4**:785-832, 1918.

15. Mann, I., and Pullinger, B. D.: The Pathological Effects of Mustard Gas on the Eye of the Rabbit, personal communication to the authors.

observed these crystals being deposited along the vessels which invade the cornea contaminated with mustard gas in experimental animals.

Loosening of the Epithelium.—It has been observed in experimental mustard gas lesions of the eye that the epithelium which grows over the damaged stroma is loosely attached and remains so until the stroma returns to normal.[16] This loosely attached epithelium is easily rubbed off, exposing the underlying abnormal stroma to infective agents. This sequence, which we have frequently observed in experimental animals, may well be the mechanism by which relapsing keratitis is caused in man.

SUMMARY AND CONCLUSION

One hundred and thirty-six cases (including 84 reported by Mann) of chronic and recurring mustard gas burns of the eye have been collected and analyzed. No essential difference is found between cases of the chronic and cases of the recurrent type. In the average case there were few, if any, complete remissions, and the condition progressed steadily over one or more decades to serious visual loss. The lesions had a characteristic clinical appearance. They were usually bilateral and involved chiefly the exposed palpebral aperture. The conjunctiva generally showed a marbled appearance, with ischemic areas surrounded by dilated, tortuous veins of irregular caliber. The corneal ulcers, when they occurred, might be shallow or deep and might occur at any location on the cornea, frequently at the limbus. The edges of the ulcers were raised and irregular. In some cases the scars became partially calcified.

No universally beneficial treatment has been reported. Curettage of the diseased corneal tissue and tarsorrhaphy seem to have been somewhat efficacious in shortening the duration of the relapse. Corneal transplants have not been tried and may be of benefit. The use of contact glasses to promote healing of the recurrent ulcers and to improve the patient's vision has been the most successful treatment reported.

Johns Hopkins Hospital.

16. Scholz, R. O.: Clinical and Pathological Studies of Ocular Mustard Gas Burns, unpublished data.

A SQUINT SYNDROME

KENNETH C. SWAN, M.D.
PORTLAND, ORE.

IN 1934 Braun [1] called attention to the fact that the normal "blindspot," resulting from the absence of perceptive elements in the optic papilla, may form the nucleus of a suppression scotoma in the squinting eye. Seven cases of esotropia are now reported as representative of a clinical entity in which the physiologic blindspot seems to play an exceptional role as a central scotoma in the squinting eye. Recognition of the "blindspot" syndrome is important because it seems common and remediable. Restoration of comfortable single binocular vision results if treatment is properly directed, whereas partial or improper measures are of little benefit and may add to the patient's distress.

Recognition of this syndrome resulted from determination of the field of binocular vision in 296 cases of concomitant esotropia in older children and adults. The field of binocular vision was plotted by the use of colored filters and twin projection systems of the type described by Lancaster.[2] For example, a red filter was placed before the fixating eye, and for a fixation point a small red disk of light was projected onto an unmarked white screen. A green filter was placed before the squinting eye and a green disk of light projected on the screen at various positions to plot the field of vision of this eye. The fixating eye viewed only the red light and the squinting eye only the green light. The patient was not required to distinguish the color of the peripheral green image, but was asked only to perceive a second light. This method permitted plotting of the fields of vision at fixation distances of 0.5 to 6 meters. The test was performed in an illuminated room to simulate as nearly as possible the conditions under which the eyes are used normally. For the proper interpretation of such a test, the deviation of the eyes and the state of retinal correspondence had to be known. The deviation of the eyes during the test was measured by corneal reflex (Priestley Smith tape and perimeter) and prism cover test methods.

From the Departments of Ophthalmology, the University of Oregon Medical School and the State University of Iowa College of Medicine.

1. Braun, G.: Gesichtsfelduntersuchungen bei Schielenden, Klin. Monatsbl. f. Augenh. **92**:600-613 (May) 1934.

2. Lancaster, W. B.: Detecting, Measuring, Plotting and Interpreting Ocular Deviation, Arch. Ophth. **22**:867-880 (Nov.) 1939.

The state of the retinal correspondence was determined by the major amblyoscope and after-image tests, as well as by the red-green method.[3]

In accordance with the finding of Travers,[4] the "object of regard," that is, the point of fixation and the immediately surrounding area, seemed to be perceived monocularly in most cases of long-standing untreated concomitant esotropia. Travers expressed the belief that this monocular perception of the "object of regard" was due to suppression of the image in the peripheral retina of the squinting eye; however, in many of my cases it was demonstrated that rays of light from the objects fixated by the fovea of the fixating eye fell on the optic papilla of the squinting eye. In such instances, an absolute scotoma, the physiologic blindspot, was provided by nature. Esotropia of 12 to 17 degrees for distance fixation results in the areas in the field of binocular vision corresponding to the fovea of each eye being overlapped by the physiologic blindspot of the opposite eye.

In 80 of my 296 cases of concomitant esotropia, the physiologic blindspot of the squinting eye was found to overlie the point of fixation when measured at distances of 0.5 to 6 meters with the color filter projection method previously described. It was impossible in most of these cases to do more than theorize as to the possible role played by the physiologic blindspot because it was only part of a large scotoma in the squinting eye. There were, however, 7 cases in which it seemed probable that the physiologic scotoma alone provided a mechanism for partial alleviation of diplopia. In these 7 cases the blindspot of each eye consistently overlapped the central area of the opposite eye at all distances of fixation, and no other scotoma could be plotted in the field of binocular vision. The pertinent features, treatment and course in each of the 7 cases are presented.

Case 1.—A 15 year old white girl had acquired convergent strabismus associated with diplopia at the age of 7 years. When she was 10, glasses were prescribed, and a recession of the medial rectus muscle of the right eye was performed by an ophthalmologist. The deviation appeared to be corrected, but postoperative diplopia was so annoying that it was necessary for the child to withdraw from school. Disappearance of constant diplopia six months later was associated with return of the strabismus. At the time of my examination the patient still had periodic diplopia and a concomitant esotropia of 14 to 16 degrees for distance fixation. Cycloplegic refraction revealed 3 D. of hyperopia and 1 D. of astigmatism in each eye. Visual acuity was 20/20 in each eye with correcting lenses. The only scotomas which could be plotted in her fields of binocular vision with the color filter projection method were the normal physiologic blindspots. The blindspot of the squinting eye was found to overlie the point of fixation at all fixation distances from 0.5 to 6

3. Swan, K. C.: Definition of Anomalous Retinal Correspondence, Am. J. Ophth. **28**:58-61 (Jan.) 1945.

4. Travers, T. a'B.: The Origin of Abnormal Retinal Correspondence, Brit. J. Ophth. **24**:58-64 (Feb.) 1940.

meters. Retinal correspondence was normal with the after-image test. Diplopia was constant with prisms partially correcting the deviation; however, with the major amblyoscope adjusted to correspond to the deviation, the patient was able to fuse even the most complex picture targets with a convergence-divergence amplitude of 5 to 7 D. and described stereopsis. Corrective lenses were prescribed and daily orthoptic exercises initiated with the major amblyoscope. A convergence-divergence amplitude of 25 D. developed after several weeks of training, but the deviation remained unchanged. A 5 mm. recession of the medial rectus muscle of the left eye was then made. Postoperatively, the patient was able to maintain single binocular vision for fixation beyond 0.5 meter, but several months of daily home training with the Brewster-Holmes stereoscope was required to establish comfortable single binocular vision for reading. At the completion of this period, with the Maddox rod the patient had 2 D. of esophoria for distance and 1 D. of esophoria for near fixation. There was no hyperphoria. Prism convergence was 25 D. and divergence 5 D. The vertical vergences were 3 D. The patient was able to bar read. She did her school work comfortably and had no change in status during the three years that she was observed after operation.

Case 2.—A 9 year old boy had had convergent strabismus since infancy. When the boy entered school, at the age of 7, he had difficulty in learning to read and described double vision. An optometrist prescribed glasses and "exercises," but the eyes remained crossed and periodic diplopia persisted. Examination on his admission revealed uncorrected visual acuity of 20/20 in each eye, but with cycloplegia he had 2 D. of hyperopia. There was an alternating concomitant esotropia of 12 to 17 degrees for distance fixation. In the field of binocular vision the point of fixation was overlapped by the blindspot of the squinting eye at all distances. Retinal correspondence was normal with the after-image test. With the major amblyoscope, the patient was able to fuse various standard slides after the targets were adjusted in the instrument to correspond to the deviation of the eyes, but his amplitude of fusional movements was limited to a few diopters. Lenses and orthoptic exercises were prescribed. Six weeks later, when he had acquired an amplitude of fusional movements of 15 D. on the major amblyoscope, a recession of 5 mm. was done on the medial rectus muscle of the left eye. This procedure effected only a partial correction of the deviation, and as a result diplopia was constant postoperatively. An occluder was prescribed for one eye, which was worn except when he was taking orthoptic exercises with a prism stereoscope. Two months after the first operation a recession was performed on the medial rectus muscle of the right eye. The patient had single binocular vision under room conditions on the first postoperative day. No deviation was perceptible with the cover test, and with the Maddox rod he had only 1 D of esophoria for distance and 2 D. of exophoria for near fixation. Prism convergence was only 7 D and prism divergence 2 D.; therefore, orthoptic exercises were continued at home for a month after operation. At the end of that period prism convergence had increased to 12 D., and the patient was able to bar read. He was able to read with comfort and progressed rapidly in school during the following two years of observation.

Case 3.—A boy aged 11 was referred to me with a diagnosis of "horror fusionis." Convergent strabismus had been present since infancy. When the boy started school, he had difficulty in learning to read because of periodic double vision. Glasses correcting his 3 D. of hyperopia did not seem beneficial; therefore, the attending ophthalmologist did a recession on the medial rectus muscle of the right eye. Postoperative diplopia was constant and necessitated the boy's with-

drawal from school for a year. At the end of this period the eyes had returned to the squinting position and the diplopia had become periodic. My examination, two years later, revealed concomitant esotropia of 14 to 16 degrees for distance fixation, with overlapping of the point of fixation by the physiologic blindspot of the squinting eye. Diplopia could be created under room conditions by partially correcting the deviation with prisms. Retinal correspondence was normal in the after-image test. With the major amblyoscope adjusted to the deviation of his eyes, the patient was able to fuse even the most complex stereoscopic tragets, but his amplitude of divergence and convergence was limited to several diopters. Monocular occlusion was prescribed, and orthoptic exercises were initiated to develop a large amplitude of fusional movements before operation. After fourteen orthoptic sessions of thirty minutes each with the major amblyoscope he was able to fuse the standard stereoscopic targets over a range from 16 to 27 degrees of convergence. A recession of the medial rectus muscles was then performed, which reduced the deviation to 2 degrees of esophoria. On the first postoperative day the boy had single binocular vision for all objects beyond 1 meter. After one week of orthoptic training he was able to fuse larger objects at 30 cm. but was unable to read fine print with both eyes without a spasm of accommodation. At the end of two weeks of orthoptic training he was able to read the finest newspaper print through a bar reader. When last seen, one year after operation, the boy had comfortable single binocular vision. With the Maddox rod, he had 2 D. of esophoria for distance and 1 D. of exophoria for near fixation. Prism divergence was 4 D. and prism convergence 14 D. One diopter of left hyperphoria was corrected by incorporating a prism in his glasses. Stereopsis was present.

Case 4.—An 8 year old boy had had crossed eyes since infancy. Glasses had been prescribed when he was 2½ years old, and an operation had been performed on the right lateral rectus muscle at the age of 5 years, but no improvement was noted. When the boy started school, at the age of 7, he complained periodically of diplopia. Exercises with a prism stereoscope were begun under the supervision of an ophthalmologist but were discontinued when no benefit was evident. One year later the patient was admitted to my service with the complaint of double vision and inability to read comfortably without closing one eye. The pertinent findings were a refractive error in each eye of 1 D. of hyperopia associated with 1 D. of astigmatism and right concomitant esotropia of 13 to 15 degrees for distance fixation, and overlapping of the fixation point by the blindspot of the right eye. Under room conditions, diplopia resulted with 30 D. of prism base out, but with the major amblyoscope adjusted to from 11 to 16 degrees of convergence the boy was able to fuse even the most complex stereoscopic targets. Retinal correspondence was normal in the after-image test. Correcting lenses were prescribed, and a recession of the medial rectus muscle of the right eye was made after two weeks of orthoptic exercises. When the bandages were removed, on the second postoperative day, the patient had single binocular vision. With the Maddox rod he had 1 D. of espohoria for distance and 3 D. for near fixation. There was no vertical deviation. Prism convergence was 16 D., and prism divergence was 4 D. He was able to bar read after several days of intensive orthoptic training. Further orthoptic exercises were considered unnecessary, for the boy had comfortable single binocular vision and a large reserve of fusional movements. Reexamination a year later revealed no change in his status.

In the successful treatment of the preceding 4 patients, corrective lenses, orthoptic measures and surgical procedures were utilized fully. In the following 2 cases partial measures were attempted.

CASE 5.—A girl aged 14 had had convergent esotropia and periodic diplopia since the age of 4 years. Repeated changes of glasses did not seem to affect the deviation or diplopia; an operation was therefore performed by an ophthalmologist when the child was 8 years of age. After operation, the patient had constant diplopia until the squint returned to its former deviation, three months later. The parents were so discouraged that no further care was given the patient's eyes until my examination, six years later. With cycloplegia, the right eye was found to have 2 D. of hyperopia and the left eye 4 D. of hyperopia with 2 D. of astigmatism. Maximal visual acuity was 20/20 in the right eye and 20/20—5 in the left eye. The deviation and other measurements were otherwise similar to those in the preceding cases. Orthoptic treatments were not possible, for social and economic reasons; therefore, after correcting lenses had been worn for three months, operation was performed, at the family's insistence for purely cosmetic reasons. Recession of the medial rectus muscle of one eye resulted in reduction of the deviation to 3 degrees of esotropia. Constant diplopia was evident on the first postoperative day and persisted for about six weeks. Reexamination two months after operation revealed that the deviation was only 2 degrees less than that measured preoperatively. The parents were dissatisfied and refused further treatment.

CASE 6.—A girl aged 19 had a history similar to that in the preceding cases, that is, one of convergent strabismus and periodic diplopia, not benefited by the usual procedures. At the age of 8 and again at the age of 13 she had undergone operation for esotropia. Each operation had been followed by a period of partial correction of the deviation associated with constant diplopia. The clinical findings were similar to those in the preceding cases except for a larger degree of anisometropia. Her refractive error was less than 1 D. of simple hyperopia in the left eye and 3 D. of hyperopic astigmatism at an oblique axis in the right eye. I advised the patient that another operation, as well as orthoptic measures and lenses, would be required before her eyes could be corrected. She refused treatment because of her previous unfortunate experience with operations.

CASE 7.—A medical student aged 24 stated that his eyes had been crossed in childhood but had been corrected with glasses. He stated that he had had diplopia for years but it bothered him only when he "thought about it." Examination revealed concomitant esotropia of 12 to 14 degrees for distant fixation, associated with 4½ D. of hyperopia and 1½ D. of astigmatism in each eye. Visual acuity was 20/20 with correction. Retinal correspondence was normal. Overlapping of the fixation point by the normal blindspot of the squinting eye could be plotted accurately with the red-green projector system. No treatment other than the prescription of glasses was undertaken in this case because the patient had learned to compensate for his diplopia and the cosmetic defect was not conspicuous. The deviation was less apparent because the patient had a positive angle gamma of 2 degrees in each eye, a wide interpupillary distance and prominent eyes.

COMMENT

The similarity in histories and clinical findings in the aforedescribed cases is striking; however, other features may be evident when additional cases are studied by methods other than those which I used. Certainly, 7 cases do not constitute an adequate series from which to draw conclusions concerning therapeutic measures, but it is noteworthy that in 4 of the cases unsuccessful surgical measures

had been performed prior to the patient's admission. In the fifth case, an operation which I performed for cosmetic purposes was unsuccessful. It seems, therefore, that operation unaccompanied with orthopic procedures is not likely to be successful in these instances and may increase the patient's distress by making diplopia constant. Likewise, glasses and orthoptic procedures seem of little benefit without accurate surgical correction of the deviation. It should be noted, however, that no patient whom I observed was under 8 years of age. Strabismus recognized earlier in childhood might be more amenable to the nonoperative procedures.

SUMMARY

Seven cases of esotropia are reported as possible examples of a clinical entity in which the squinting eye is so deviated that its physiologic blindspot plays a special role as a central scotoma. The history is that of a mild degree of convergent strabismus with periodic diplopia. The syndrome consists of hypermetropia or anisometropia, esotropia of 12 to 17 degrees for distance fixation, normal retinal correspondence and a binocular visual field in which the physiologic blindspot of the squinting eye constantly overlies the point of fixation. Fusional ability, with a limited amplitude of convergence and divergence, can be demonstrated by haploscopic devices adjusted to the deviation of the eyes.

The prognosis for restoration of comfortable single binocular vision is excellent if this "blindspot syndrome" is recognized and treatment is properly directed. In addition to glasses and surgical measures, orthoptic training must be utilized to develop an adequate amplitude of fusional movements and to establish a proper convergence-accommodation mechanism; otherwise, postoperative diplopia is annoying, and there is a tendency for the eyes to return to the squinting position.

3181 S.W. Marquam Hill Road.

DERMATOMYOSITIS WITH RETINOPATHY

Report of a Case

JACK V. LISMAN, M.D.
NEW YORK

DERMATOMYOSITIS is a rare disease of protean manifestations. It is characterized clinically by degeneration of many of the muscles of the body together with a nonsuppurative inflammation and atrophy of the skin and mucous membranes. Involvement of the retina is the rarest manifestation of this rare syndrome. The retinal involvement was first noted by Bruce [1] in 1938 in a report of 3 cases, in 1 of which autopsy was performed, with histologic examination of the posterior segment of the eye. The case to be reported represents a second one in which histologic examination of the eye at autopsy was possible.

CLINICAL FEATURES

The disease was first described in 1863 by Wagner.[2] It may appear acutely, with severe and rapidly progressive symptoms; or it may be seen in a subacute or chronic form, with remissions and exacerbations and sometimes complete recovery. In 2 of the 3 cases reported by Bruce [1] the patient recovered, and there was complete absorption of the retinal lesions. The chronic form is usually insidious in onset, with fever of low degree, malaise, anorexia, loss of weight and weakness. A rash is usually associated at some stage and is variable. The most characteristic cutaneous lesion is patchy erythema, which is faintly indurated, slightly scaly and dry. Keil [3] noted a characteristic facies composed of two elements: (1) definitely swollen eyelids with some swelling of the adjacent portion of the cheeks and nose, and (2) a background of faint rosy or pale blue skin.

The net effect of these appearances is to create a sort of heliotropic bloating of the face, resembling the early stages of cadavaric decomposition.

From the Neurological Service of Dr. Nathan Savitsky, Morrisania City Hospital.

Read at a meeting of the New York Academy of Medicine, Section of Ophthalmology, Nov. 1945.

1. Bruce, G. M.: Retinitis in Dermatomyositis, Tr. Am. Ophth. Soc. **36**: 282-297, 1938.

2. Wagner, E.: Fall einer seltnen Muskelkrankheit, Arch. f. Heilk. **4**:282, 1863.

3. Keil, H.: Manifestations in Skin and Mucous Membranes in Dermatomyositis, with Special Reference to Differential Diagnosis from Systemic Lupus Erythematosus, Ann. Int. Med. **16**:828-871 (May) 1942.

The mortality rate is 50 per cent. Calcinosis universalis sometimes occurs, with deposition of calcium in the subcutaneous tissues, muscles and joints. The outcome when recovery occurs is likely to be marked by residual muscular atrophy and permanent cutaneous changes. The muscles of the shoulder girdle, arms and legs are particularly susecptible. O'Leary and Waisman [4] noted that the distal musculature of the extremities suffers less than the proximal. The muscles are characteristically painful and tender to the touch. Muscular atrophy occurs, and the disease is frequently associated with muscular contractions and fixed joints. The mucous membranes of the mouth and the conjunctiva frequently share in the nonsuppurative inflammation that involves the skin. Depending on the degree of muscular involvement, the symptoms are referable to many of the body systems; weakness of the trunk and the extremities, as well as hoarseness and dysphagia, are seen. Involvement of the diaphragm and intercostal muscles produces dyspnea; bronchopneumonia and respiratory paralysis are the usual causes of death. Erysipelas may develop, with overwhelming toxicity and death. Cardiac failure may be caused by involvement of the heart muscle; electrocardiographic abnormalities are frequent. Sphincteric weakness is found. Subcutaneous edema is a common finding and may be firm or pitting. The distribution of the cutaneous manifestations is not determined by the extent of muscular involvement. Mild pigmentary and atrophic changes of skin may be seen over the joints.

Dermatomyositis may involve the eyes in many ways.

Eyelids.—In the average case the eyelids represent the first tissues to be involved, and the appearance exhibited by the lids is of cardinal importance. Involvement of the lids may be the only cutaneous sign. As a rule the lids are swollen and pink. Careful examination will reveal that the rosy hue is due to the presence of numerous, closely set telangiectases. The edematous area of infiltration will generally pit on pressure and is very loose; the lower lids may hang in folds. In some cases the edema is firm. The lids may be tender to the touch, owing to involvement of the orbicularis oculi. The edema of the lids in this disease is differentiated from that due to glomerulonephritis by the presence of telangiectases and the absence of renal involvement. The association of edema of the lids and muscular pains gave rise to the old name of pseudo trichinosis; the differentiation from true trichinosis is made by the presence of the inflammatory reaction, i. e., the erythema, telangiectasia and pigmentation. Subconjunctival hemorrhage, which is likely to occur in trichinosis, is not seen in dermatomyositis. The edema of the lids is differentiated from that of angioneurotic edema by the

4. O'Leary, P. A., and Waisman, M.: Dermatomyositis, Arch. Dermat. & Syph. **41**:1001-1019 (June) 1940.

transitory nature and the lack of inflammatory reaction in the latter. The telangiectasia is best seen by spreading the lids and rendering them taut, for the small telangiectatic patches may be obscured by the overhanging folds. The edema of the lids associated with sinusitis has its maximum intensity close to the root of the nose. In the later stages of the disease a reticulated pigmentation and superficial localized atrophy replace the edema.

Conjunctiva.—The conjunctiva is not so frequently involved as the mucous membranes of the mouth and pharynx. The conjunctiva may be hyperemic, corresponding to the telangiectasia of the skin. This sometimes gives a bluish red color to the palpebral portion. Paralysis of the extraocular muscles due to local muscular involvement has been reported, and diplopia is a rare symptom. Varying degrees of ptosis, strabismus, iritis, nystagmus and exophthalmos have been reported as well. The presence of retinal hemorrhages and exudates was first noted by Bruce [1]; the clinical picture and the histologic changes seen in the retina in his cases are similar to those in the case to be reported.

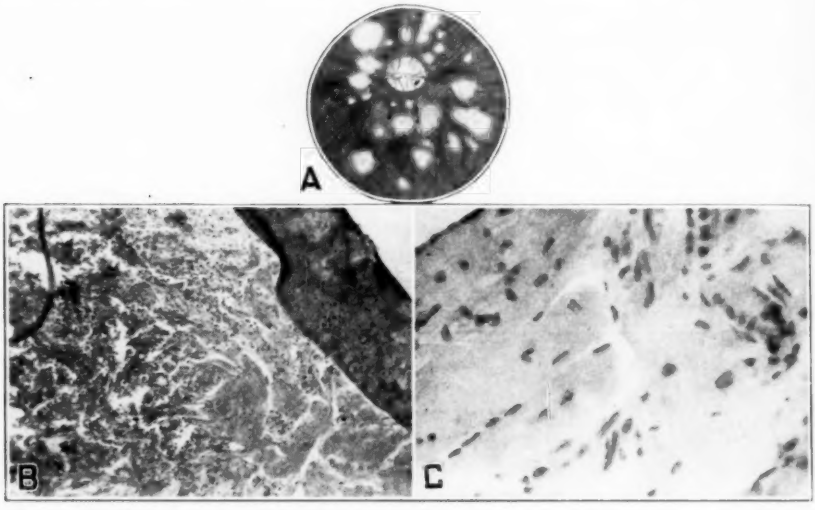
REPORT OF CASE

History.—S. W., a white man aged 53, was observed for the first time on Jan. 28, 1941, on his admission to the neurologic service of the Morrisania City Hospital. The main complaint was generalized weakness, of six months' duration. This had been steady and progressive, and by the time the patient had come under observation at this hospital he was barely able to sit or stand erect unaided. There had been a loss of weight of 20 pounds (9.1 Kg.) since the onset of weakness. Two months prior to his admission the eyelids had begun to swell, and the swelling had persisted. There had been increasing stiffness of all joints of the body with severe pain on extension, especially at the elbows and fingers. The voice had become progressively lower in pitch. There was considerable difficulty in swallowing. A cough, productive of a moderate amount of sputum, had been present for the week preceding admission. There had been one episode of hemoptysis. A rash had appeared over the face in the butterfly distribution, as well as over the shoulders and the tips of the fingers.

Examination.—Examination on his admission to the hospital revealed an emaciated man, with a pinched, painful facies. The patient was alert, oriented and cooperative. He preferred to lie quietly in bed in a position of generalized semiflexion and was able to sit erect only when aided. Forced extension at the elbows or knees resulted in great pain. The muscles of the trunk and extremities were extremely tender; lying prone or supine was equally painful. There was a disseminated cutaneous rash in various stages of atrophy. A deep subcutaneous inflammatory reaction was present over the palmar surface of all the fingers, with several patchy areas of necrosis. The inflammation was limited to the palmar surface only. Decubitus ulcers were present over the hips, shoulders, elbows and heels. An erythematous, atrophic eruption was present on the face in butterfly distribution. An erythematous, scaly eruption was present over the entire back. The eyelids were moderately edematous and did not pit on pressure. A few small telangiectases were present in one upper lid. The biceps were small, tense and fibrous to the touch. There were generalized weakness and muscular

atrophy. Fibrillary twitchings of the tongue were seen. There were no focal neurologic signs. Examination of the chest revealed no signs of a pathologic process in the lungs. There were no evident clinical cardiac abnormalities.

Ophthalmic Examination.—Examination of the fundi revealed numerous areas of retinal exudate reminiscent of cotton wool patches (figure, *A*). These areas were at the posterior pole and surrounded the disk and macula. They varied in size from small dots to areas as large as the disk. The color was grayish yellow with a rather dull surface. They were not well circumscribed and tended to fade out into normal retina. For the most part they overlay the vessels, but occasionally they were deep. They were roughly circular and tended to coalesce. Numerous hemorrhages were seen intermingled with the exudate; these were of both the deep round and the superficial striate varieties. The retinal picture was not at all static, and new hemorrhages and exudates appeared as others were absorbed during the short interval that the patient was under observation. The disk and the vessels were normal.



A, artist's conception of the fundus picture; *B*, histologic section of skin, showing the cellular infiltration in the corium and collagen deposited; *C*, histologic section of pectoral muscle, showing increased cellularity, fragmentation of muscle fibers and loss of striation.

Laboratory Data.—The Wassermann and Kahn reactions of the blood were negative. The urea nitrogen content of the blood was 20 mg. per hundred cubic centimeters. The total serum protein was 4.99 mg. per hundred cubic centimeters, with an albumin: globulin ratio of 1.41. The nonprotein nitrogen measured 38.8 mg. Sugar tolerance studies revealed a normal curve. There were no urinary abnormalities. The electrocardiogram revealed low voltage in all leads, with the T waves depressed in all leads.

Course of Illness.—The patient had a low grade fever, with a temperature between 100 and 101 F., until the tenth day of his stay in the hospital, when his temperature rose to 104 F. Facial erysipelas appeared as well as bronchopneumonia. The course was progressively downhill, and he died on the twelfth day after admission.

Autopsy.—Autopsy was performed within a few hours after death. Death was reported as due to bilateral bronchopneumonia and streptococcic cellulitis of the face, scalp and mediastinum. The brain showed evidence of slight toxic encephalopathy. Microscopic sections of skin showed thinning of all the layers with dyskeratosis (figure, *B*). The rete pegs were prolonged into the corium. In the latter there was pronounced degeneration of the fibers with collagenous deposits; localized areas of necrosis were present, with an exudate of polymorphonuclear cells and increased vascularity (figure, *C*). The degenerative process and collagen deposits extended into the subcutaneous fat. Histologic examination of muscle revealed an exudate between the muscle bundles, infiltrating and destroying muscle fibers. The exudate was perivascular for the most part and consisted of lymphocytes and large mononuclear cells. There was some proliferation of connective tissue, with replacement of muscle fibers. The muscle fibers in many areas were fragmented and had lost their striations and stained lightly. The arterioles showed thinning with narrowing of the lumen and occasional thrombus formation. Changes were seen in the muscles of the heart and diaphragm and in the biceps and pectoral muscles. Examination of the sectioned eye, as reported by Dr. C. Perera, showed slight postmortem changes in the retina. There were occasional hyaline or lipid changes in the external plexiform layer, especially around the macula. A few small scattered hemorrhages were seen at various layers of the retina. Except for these changes, the eye was completely normal. The vessels showed no pathologic change.

SUMMARY

The case of dermatomyositis reported here is unusual because of the associated retinopathy. This is the second case of this kind in which histologic studies were made. The pathologic process is not specific for this disease.

654 Madison Avenue.

DISCUSSION

DR. CHARLES A. PERERA, New York: There was nothing specific about the retinal lesions, which consisted in deposits in the external layers of the retina. One could not make the diagnosis from the retinal picture alone. However, the changes in the 2 cases, that of Dr. Lisman and that of Dr. Bruce, were similar.

PHARMACOLOGIC ACTION OF SOME OPHTHALMIC DRUGS

WALTER MODELL, M.D.
NEW YORK

DESPITE the fact that most drugs used in ophthalmology are applied directly to the eye, information about their absorption from the surface of the globe is scanty. Only in the case of some of the latest additions to ophthalmic medicine, the sulfonamide drugs and penicillin, has the problem of absorption from the site of their application been systematically studied.

It might be expected, since the conjunctiva is not, like the intestinal tract, provided with special mechanisms for absorption, that absorption from its surface would be very poor. However, as ophthalmologists have long known, it is a good absorbing surface for many drugs. Satisfactory effects are obtained after the local instillation of miotics, mydriatics, cycloplegics, anti-infectives, anesthetics and others. Macht [1] showed that after apomorphine had been placed on a dog's eye vomiting occurred in a few minutes, indicating exceedingly prompt absorption of that drug from the conjunctival sac into the blood stream.

The general phenomenon of absorption has been the subject of considerable recent investigation, and several factors have been determined which influence the rate of absorption from and penetration through skin and mucous surfaces, and which appear to operate in the case of the eye as well as in other parts of the body. Detailed data concerning these factors have now been accumulated which make it possible for the ophthalmologist to prescribe drugs used locally in the eye in the form in which they are most effectively absorbed. For example, it has been shown that the lower the surface tension, i. e., the greater the surface activity of a solution, the more rapidly drugs contained in it penetrate the conjunctiva.[2] Thus, a solution of an alkaloid or sulfadiazine can be made to penetrate much more quickly if to its solution a detergent, or wetting agent, is added. Many such surface tension–lowering agents are now known; their production has been stimulated for industrial reasons. They

---

From the Department of Pharmacology, Cornell University Medical College.

Read before the New York Society for Clinical Ophthalmology, Nov. 5, 1945.

1. Macht, D. I., and Teagarden, E. J., Jr.: The Effect of Light on the Behavior of Rats After Injections of Quinin and Quinidin Sulphates, J. Pharmacol. & Exper. Therap. **22**:21 (Aug.) 1923.

2. Bellows, J. G., and Gutmann, M.: Application of Wetting Agents in Ophthalmology, with Particular Reference to Sulfonamide Compounds, Arch. Ophth. **30**:352 (Sept.) 1943.

decrease the interfacial tension between air and liquids and make the contact between solutions and the conjunctival surface more intimate. Dermatologists have been using wetting agents for some time to promote penetration of the skin, but their use in ophthalmology has been more recent. Attention has been called to the fact that many of them are far too toxic for use in medicine. Some of those which can be used on the skin are irritant to the conjunctival surface in even moderate concentration. But when required, effectual concentrations of some of these wetting agents may be used with safety.[3]

The osmotic tension of solutions also influences the rate of absorption. The closer the approach to isotonicity, the more rapid the absorption. Tables on the tonicity of solutions of various ophthalmic drugs, indicating the amount of salt necessary to add to make them isotonic with tears, are available.[4] The p_H of solutions is important in modifying the absorption as well as the irritant properties of solutions used on the eye. The closer the approach to the physiologic p_H of about 7.5, the less the conjunctiva is irritated.[5] Most, but not all, ophthalmic drugs are best absorbed from the conjunctiva when in alkaline solution. Shifting from an acid to an alkaline p_H may increase absorption as much as twenty times in the case of certain drugs. Buffer solutions may be prepared with which one can make solutions of optimal p_H of virtually all ophthalmic drugs. Tables for their preparation have been published.

Ophthalmic prescriptions should, therefore, take into consideration the surface tension, p_H and osmotic tension. It is possible to combine all these factors in a solution compatible with an effective concentration of most drugs so that a nonirritant, well absorbed, pharmacologically active preparation is obtained.

I shall consider here only the anti-infective and the choline group of drugs.

ANTI-INFECTIVE DRUGS

The two new anti-infective drugs, the sulfonamide compounds and penicillin, are so superior to anything before available that there should now also be new and higher standards of antibacterial effectiveness. It is worth while to evaluate the older local antiseptics in the light of such new standards to see whether they still have any place in the treatment of local infections of the eye.

---

3. Leopold, I. H.: Local Toxic Effect of Detergents on Ocular Structures, Arch. Ophth. **34**:99 (Aug.) 1945.

4. Cogan, D. G., and Hirsch, E. O.: The Cornea: VII. Permeability to Weak Electrolytes, Arch. Ophth. **32**:276 (Oct.) 1944.

5. Elvin, N. C.: The p_H and Tonicity of Ophthalmic Solutions, Arch. Ophth. **29**:273 (Feb.) 1943. Cogan and Hirsch.[4]

An antiseptic is a substance which retards the development of disease-producing bacteria. There are a host of such substances. It is possible to demonstrate many apparently desirable and useful properties of these antiseptic substances in the test tube. Some can be shown to have certain bacterial specificities, while others are polyvalent; some penetrate agar gels well; the potency of others seems not to be disturbed much by the presence of pus, protein or tears; some can be shown not to interfere much with the in vitro activity of leukocytes or fibroblasts, and some seem to be potent in exceedingly high dilution. But however strongly such information seems to indicate that a chemical antiseptic is desirable, the best evidence is that in vitro information has no bearing on the results which may be obtained in vivo or on the usefulness of the drug in the local treatment of infections of the skin and mucous surfaces of the body. The in vivo test is the only true test of the effectiveness of a substance.[6]

The body has potent and useful antibacterial properties of its own. It has been shown that chemical antiseptics may interfere with these normal anti-infective actions in the body. Lysozyme is an important natural antibacterial agent in tears. There is evidence adduced by Fleming[7] long before he discovered penicillin that when lysozyme is mixed with some chemical antiseptics the two may prove to be mutually antagonistic and vitiate promptly each other's antibacterial properties. Such a reaction developing between the lysozyme in tears and a chemical antiseptic instilled in the conjunctival sac therefore strongly favors the development of bacteria. If local irritation should follow the use of the chemical antiseptic, bacterial growth would be still further enhanced.

During World War I, when there were no sulfonamide drugs or penicillin, local antiseptics were freely used in wounds. Many studies even then indicated that the best results were obtained when contaminated wounds were irrigated with sterile saline solution, and not when treated with antiseptic solutions. This fact is now more generally recognized. There is considerable evidence to show that sterile wounds heal far more rapidly when no antiseptics are applied. The indications are that when no infection is present the local use of antiseptics retards healing, and that when infection is present strong chemicals may retard the eradication of the bacteria as well.[8] The usefulness of local antiseptics is indeed limited in most parts of the body, and I doubt whether the eye is an exception to this rule.

---

6. Conferences on Therapy: Evaluation of Local Antisepsis, New York State J. Med. **44**:2606 (Dec. 1) 1944.

7. Fleming, A.: Antiseptics and Chemotherapy, Proc. Roy. Soc. Med. **33**: 127 (Jan.) 1940.

8. Fleming, A.: The Action of Chemical and Physiological Antiseptics in a Septic Wound, Brit. J. Surg. **7**:99 (July) 1919. Footnote 6.

The reason that the sulfonamide drugs seemed so miraculous is that they were the first polyvalent anti-infective agents that did the work which had so long been hoped for from chemical antiseptics. The sulfonamide compounds may be an old story today, but there are still important infections in the treatment of which penicillin is ineffectual and for which the sulfonamide compounds can be used to advantage.

I should like to press the question of the local use of sulfonamide drugs as against their systemic administration in the treatment of infections in the eye. Originally it was thought that local use was desirable, since it would produce high concentrations of the drug at the site of application. An experience has accumulated which has led to the questioning of this hypothesis. Unfavorable results have followed indiscriminate application of sulfonamide drugs directly to the peritoneal sac, as well as to other body cavities and surfaces. In the beginning of World War II, the sulfanilamide powder dispenser was a much used item in the official first-aid field kit, and the contents were freely dropped into field wounds. Before the war was over, by Army directive, these dispensers were removed from the kits, and soldiers wounded on the field were given sulfonamide tablets orally instead. The results following oral administration were far superior to those obtained with local use. The powders, used locally, delayed healing, while bacterial eradication was effective by oral administration.

All evidence indicates that the sulfonamide drug operates from the interior of a cell, and not as a surface-acting material. Its presence inside the cell is important, and systemic administration seems to be the most efficient method of getting the drug there. This has been supported by many observers and is the conclusion of a recent extensive report.[9] There seems to be little in support of the local use of sulfonamide drugs. With respect to the eye, there is evidence that after systemic administration high concentrations in the globe are achieved, while absorption from the surface is not great. In addition, although all do not agree, some investigators have found that its local use delays healing.[10] Many ophthalmologists continue to use sulfonamide drugs locally for ocular infections, but it might be well for them to examine their results more critically.

Penicillin has taken the limelight in general medicine and an important spot in ophthalmic medicine as well.[11] It is absorbed from the surface

9. Meleney, F. L.: A Statistical Analysis of a Study of the Prevention of Infection in Soft Part Wounds, Compound Fractures and Burns with Special Reference to the Sulfonamides, Surg., Gynec. & Obst. **80**:263 (March) 1945.

10. Bellows, J. G.: Local Toxic Effects of Sulfanilamide and Some of Its Derivatives, Arch. Ophth. **30**:65 (July) 1943. Leopold, I. H., and Steele, W. H.: Influence of Local Application of Sulfonamide Compounds and Their Vehicles on Regeneration of Corneal Epithelium, ibid. **33**:463 (June) 1945.

(Footnotes continued on next page)

of the eye and when taken systemically finds its way into the globe. Penicillin is quickly eliminated from the body. Penicillin may be used locally to advantage—it is surface active against bacteria and nonirritant even in high unitage. Recently it has been shown that its oral administration is practical. About five times as much penicillin must be given by mouth to produce effects equivalent to those of intramuscular administration. Thus, 100,000 units taken by mouth is equivalent in effect to 20,000 units given intramuscularly. Much has been made of the necessity of neutralizing the acid of the stomach with a buffer when penicillin is administered orally. However, the use of a buffer is not essential, and penicillin alone taken by mouth apparently works just as well as the tablets now available, which combine the penicillin with sodium citrate.[12] A cheap and simple procedure is to use the contents of the usual parenteral ampule dissolved in tap water.

Penicillin treatment should not be terminated until an infection is completely eradicated, or relapse may develop. In penicillin therapy a continuously maintained concentration of the drug is most important. Peaks of concentration which are followed by low levels serve no useful purpose. They represent wasted penicillin. It is the highest continuously maintained level which is the effective level, no matter how high the occasional peak.

CHOLINE DRUGS

Drugs acting on the autonomic nervous system have long been used in ophthalmology; perhaps longer than in any other branch of medicine. A great deal of earlier pharmacologic information about these drugs was obtained through observations made in ophthalmology. The choline group of drugs, acting on the parasympathetic system, has only lately entered the field of ophthalmology.[13] Their parasympathomimetic action in the eye simulates that of stimulation of the oculomotor nerve, namely, miosis. This effect is produced by oculomotor stimulation, since a choline, acetylcholine, is normally elaborated at the nerve terminal when it is stimulated. It is the acetylcholine so produced which causes the miosis. In a similar manner, stimulation of the vagus nerve and its bulbar and sacral counterparts produces effects on glands, organs and blood

11. von Sallmann, L., and Meyer, K.: Penetration of Penicillin into the Eye, Arch. Ophth. **31**:1 (Jan.) 1944. Leopold, I. H., and LaMotte, W. O., Jr.: Penetration of Penicillin in Rabbit Eyes with Normal, Inflamed and Abraded Corneas, ibid. **33**:43 (Jan.) 1945. Dunnington, J. H., and von Sallmann, L.: Penicillin Therapy in Ophthalmology, ibid. **32**:353 (Nov.) 1944.

12. Bunn, P. A.; McDermott, W.; Hadley, S., and Carter, A.: The Treatment of Pneumococcic Pneumonia with Orally Administered Penicillin, J. A. M. A. **129**:320 (Sept. 29) 1945.

13. Kravitz, D.: Carbaminoylcholine Chloride in the Treatment of Glaucoma, Arch. Ophth. **32**:283 (Oct.) 1944.

vessels elsewhere in the body. The acetylcholine so produced is almost instantaneously destroyed in the body by an enzyme called cholinesterase. This destruction prevents acetylcholine from accumulating in the body. When acetylcholine is injected into the body, it produces the same effects as parasympathetic stimulation, as might be expected, since this is what parasympathetic stimulation itself does. The injected acetylcholine is also quickly destroyed by esterase. Its effects are so short lived that acetylcholine is not a clinically useful drug.

The beta-methyl derivative of acetylcholine, mecholyl chloride, is far more slowly destroyed by esterase than is acetylcholine itself. Effects are therefore of longer duration, making mecholyl clinically useful. Another choline, carbaminoylcholine chloride, called Carcholin when prepared for ophthalmic use, is not destroyed by esterase. Therefore, when carbaminoylcholine is introduced into the body, effects of much longer duration than those of mecholyl are obtained. Since it is poorly absorbed, the action of carbaminolycholine, after local instillation in the eye, is considerably enhanced by combination with a wetting agent. For this purpose zephiran chloride is often recommended.

This is only part of the story, however. Physostigmine and neostigmine, which are not choline derivatives, also simulate the effects of parasympathetic stimulation. They achieve this, however, by destroying esterase, so that acetylcholine formed during the normal physiologic tonic stimulation of the parasympathetic system is not destroyed but accumulates until pronounced parasympathetic effects are produced. After the administration of physostigmine or neostigmine, acetylcholine itself if injected produces effects of much longer duration because its destruction by esterase is delayed. The same is true of mecholyl. The reported potentiation of the effects of mecholyl in the eye by neostigmine is due to the inhibition of esterase by neostigmine. The combination of mecholyl and neostigmine produces virtually the same effect as that of carbaminoylcholine alone, since the latter needs no protection against the destruction by esterase.

Cholines can, of course, produce profound and serious systemic effects throughout the body: slowing of the heart, depression of blood pressure, violent peristalsis and intense nausea. However, large doses by mouth produce only minute effects, and parenteral administration is required to produce marked systemic actions. For this reason, there is little danger of systemic poisoning from the swallowing of choline drugs which may drain down through the nasolacrimal duct. However, when the drug is injected directly into the globe, the danger of systemic poisoning from mecholyl or carbaminoylcholine must be considered. Atropine, 1 to 2 mg. given intramuscularly or intravenously, is the best antidote and should be kept prepared for instant use.

One new derivative of carbaminoylcholine deserves special mention. This substance, called dibutoline, is a dibutyl derivative of carbaminoylcholine and was recently introduced by Swan and White.[14] The simple chemical change increases its surface activity and reduces its surface tension, so that it is well absorbed from the eye. The startling feature, however, is that this derivative of acetylcholine has exactly antagonistic pharmacologic effects to those of carbaminoylcholine, and, instead, behaves like atropine. It is a mydriatic and cycloplegic. Its mydriatic action comes on readily and lasts for nearly twenty-four hours, when it falls off quickly. Its cycloplegic action parallels its mydriatic action, so that mydriasis can be used as a measure of cycloplegia. It appears to be nonirritant and nontoxic by systemic administration in exceedingly large doses. Since it is a detergent in its own right, it shares the antiseptic action which wetting agents possess, as well as their generally good absorption.

It is interesting to speculate why there should be this reversal in effects. Why should a choline act like atropine? The best explanation is that this substance is inactive but that it competes with acetylcholine. The parasympathetic end organs do not distinguish between the two drugs because they are so similar in constitution. When the dibutoline is present, it displaces the normally formed acetylcholine and locks with the effector parasympathetic cells, blocking the tonic action of the acetylcholine. Thus, the sympathetic system is permitted to predominate. Dibutoline does not prevent the formation of acetylcholine; it merely blocks its action. The effect of dibutoline can be enhanced by combining it with epinephrine-like substances or with atropine.

It is certain that dibutoline, when it becomes commercially available, will be used in clinical ophthalmology, and it is probable that it will be used in internal medicine as well.[15]

Cornell University Medical College.

---

14. Swan, K. C., and White, N. G.: Dibutoline Sulfate: A New Mydriatic and Cycloplegic Drug, Arch. Ophth. **33**:16 (Jan.) 1945; Di-N-Butylcarbaminoylcholine Sulfate: A New Cycloplegic and Mydriatic Drug, ibid. **31**:289 (April) 1944.

15. Peterson, C. G., and Peterson, D. R.: Dibutoline: I. Pharmacodynamic Actions of a Choline Ester with Atropine-like Properties, J. Pharmacol. & Exper. Therap. **84**:236 (July) 1945.

STABILITY OF PENICILLIN IN OPHTHALMIC SOLUTIONS

ERWIN E. GROSSMANN, M.D.
MILWAUKEE

IN THE past year several reports have been made concerning the stability of penicillin in solution or in ointment mixture. Gots and Glazer [1] found that specimens of solution and ointment containing 1,000 units per cubic centimeter remain active for approximately one month at room temperature. Kirby [2] found "considerable activity" in an istonic solution of sodium chloride containing 100 units per cubic centimeter after remaining in an open bottle for five months. Stein,[3] using 19,285 units per gram, reported that his ointment retained about 80 per cent of its original strength after five weeks at room temperature in the tropics.

On the other hand Milner [4] claimed that penicillin retained its potency for only four hours when in solution (500 units per cubic centimeter) and for six hours when in ointment form (100 units per gram). Sugar,[5] using 2,500 units per gram in a water-soluble jelly base, found that the potency dropped to 80 to 90 units per gram after only fourteen days, indicating a terrific waste of penicillin. In none of these cases is it possible to compare or evaluate the results, inasmuch as not all workers compared them with controls. However, the general impression is left that the earlier reports (and some of the recent ones) erred in categorically denying the stability of such preparations. When all the evidence is weighed, it would appear that penicillin does lose its antibiotic powers fairly rapidly when allowed to remain unused in solution or in ointment form for a short period, but not as rapidly as some observers would have it appear. The last word has not yet been written concerning the chemistry of penicillin, its properties or its stability, but for the present I dare say that the use of "old" penicillin

From the Department of Ophthalmology, Regional Hospital, Camp Maxey, Texas.

1. Gots, J. S., and Glazer, A. M.: Stability and Activity of Penicillin in Solution and in Ointment, War Med. **7**:168-169 (March) 1945.

2. Kirby, M. M.: Stability of Penicillin Solution at Room and Incubator Temperature, J. A. M. A. **125**:628-629 (July 1) 1944.

3. Stein, S. H.: Penicillin Ophthalmology Ointment, Bull. U. S. Army M. Dept. **4**:8 (July) 1945.

4. Milner, J. G.: Penicillin in Ophthalmology, Brit. M. J. **2**:175-178 (Aug. 5) 1944.

5. Sugar, H. S.: Personal communication to the author.

is definitely contraindicated for parenteral use. The methods of assay are so varied that no one can be sure of the strength in terms of "unitage" in such solutions. Inasmuch as a bacteriostatic concentration in the blood and tissues must be maintained in order for penicillin therapy to be effective, it is obvious that the use of preparations containing an unknown quantity would give the user a sense of false security, and would probably be worthless in its end results. The determination of "unitage" is not insurmountable, but it is questioned whether any two laboratories could duplicate exactly each other's work in this regard. There are many uncontrollable factors that spring up in any assay study, and at best only an approximate estimate can be made. Factors such as the *p*H of the medium, the content of the medium and variations in sensitivity of strains, all have influential bearing on assay determinations.

In spite of this pessimistic outlook, it would appear that for the ophthalmologist at least penicillin solutions and ointments could be effectively used in spite of lack of knowledge of their potency. The ophthalmologist is confronted with innumerable external diseases of the eye, which in most cases lend themselves to local treatment. Patients with serious ocular diseases are nearly always hospitalized and receive treatment with penicillin by the tried and proved parenteral and iontophoretic methods. One does not risk the use of "old" penicillin in cases of such conditions as gonococcic conjunctivitis, corneal ulcer, orbital cellulitis. Yet most ocular conditions, though minor, are greatly disabling in industry or otherwise. Topical applications are in order, and an exact unitage is unnecessary. What must be sought for is a fairly stable solution that can be made up in small quantities and can be made readily available in any pharmacy for public use on prescription. This solution should be able to supply the necessary bacteriostatic concentration to the tissues involved and remain potent at ordinary room temperature, varying from that found in Maine to that in Texas. It should not be necessary to use the contents of 1 ampule in the treatment of any single patient.

With these needs in mind, an attempt was made to evaluate several preparations both clinically and in the laboratory. I have been impressed with the fact that usually no more than 10 cc. of penicillin solution containing 500 units per cubic centimeter need be used in the treatment of any individual patient.

The preliminary study included the use of several vehicles. Following the suggestion of Bellows,[6] white ointment U. S. P. containing 500 units per gram of the substance was compared with the stability of penicillin in isotonic solution of sodium chloride. This study was repeated with three different samples of penicillin. A standard loop of each preparation was inoculated on a seeded agar

6. Bellows, J. G.: Penicillin Therapy in Ocular Infections, Am. J. Ophth. **27**:1206-1219 (Nov.) 1944.

plate and allowed to incubate for forty-eight hours. This procedure was repeated every fourth day until no zone of inhibition occurred. Similar experiments were performed (repeated three times) using Aquaphor [7] as the ointment base, containing 500 units per gram. At the same time part of the material was set aside for clinical use in treatment of such conditions as catarrhal conjunctivitis, hordeolum externum and blepharitis. In each case a small portion was placed in the refrigerator to compare with that of the uncooled specimens. This preliminary work was done during the months of January through March, in Texas, and the material was allowed to remain at room temperature, which averaged from 75 to 85 F.

After approximately fourteen days all specimens of ointment showed extreme loss of potency, the greatest loss occurring in the Aquaphor mixtures. Only 1 sample of the white ointment mixture retained a potency of 50 per cent after twenty days, the others losing 60 per cent of their activity after the fourteenth day. It was also noted that the patients found use of the ointment impractical. Few became adept at introducing the ointment into the cul-de-sac with a glass rod or swab. In view of this impracticability, and because of their meager lasting power, the ointments were discarded and other vehicles were sought for. It was found that penicillin (1 ampule dissolved in 2 cc. of distilled water) mixed readily in a fine suspension with several of the oils. Cod liver oil and olive oil were chosen for further study.

The method of assay required modification after it was found that the oil tended to disperse unevenly over the surface of the agar, resulting in a variety of bizarre zones of inhibition. The ideal method proved to be that advised by Vincent,[8] with some modifications. A circular disk of heavy filter paper, 2 cm. in diameter, was saturated with 0.10 cc. of the penicillin-oil suspension and placed in the center of the seeded agar plate. Clearcut zones of inhibition resulted. This method (to be described fully) was then used for all subsequent examinations. It was found that the cod liver oil suspension retained approximately the same bacteriostatic power as did the ointments after being left unrefrigerated, at room temperature, for fourteen days. A 50 to 60 per cent loss of potency in that period still seemed to represent a terrific waste of penicillin, although clinically the results were good. However, the clinical result was quite expected, in view of the low concentration of penicillin that is necessary to inhibit the susceptible organisms.

The results with the olive oil–penicillin suspension were better. At the end of fourteen days (on the basis of measurements of the zones

7. Aquaphor (Dulse Laboratories, Inc.) is a base containing 6 per cent of a group of esters of cholesterol (chiefly oxycholesterol) in an aliphatic hydrocarbon (petrolatum) base.

8. Vincent, J. G., and Vincent, H. W.: Filter Paper Disc Modification of Oxford Cup Penicillin Determination, Proc. Soc. Exper. Biol. & Med. **55**:162-164 (March) 1944.

of inhibition) the mixture retained 85 per cent of its original strength. At the end of twenty-one days the suspension had 65 per cent of its potency. Further change of potency occurred as shown in the accompanying tabulation.

Interval, Days	Percentage
28	45
35	40
42	36
55	14
70	11

As stated previously, the penicillin mixed readily with the oil in a fine suspension. The naked eye could not detect that the mixture was not actually a solution. Ten cubic centimeters of this mixture was prescribed, and the patient was advised to instill drops every two hours with an eye dropper. The oil suspension seemed to be an ideal medium

Culture plate showing the various zones of inhibition surrounding a filter paper disk impregnated with penicillin. *A* indicates the filter paper disk; *B*, the pellucid zone of inhibition, and *C*, the clear zone of inhibition.

in that the tears did not readily wash the material out. The oil infiltrated every crevice and fold of both the upper and the lower fornix and bathed the lid margins with the same oily film. Examination with the slit lamp one hour after instillation revealed that the oily film was still present. The instillation of this mixture was not accompanied with smarting and proved effective in the treatment of acute and chronic conjunctivitis, hordeolum externum and, especially, seborrheic and

ulcerative blepharitis. However, in comparing these results in the treatment of blepharitis with those for sulfathiazole ointment over a period of many months no great difference could be noted. As to the lasting power, it seemed fairly obvious that the olive oil medium was superior to any of the ointment mixtures.

The last experiments dealt with the use of solutions. Previously, while the ointments were being experimented with, comparisons had been made with penicillin in isotonic solution of sodium chloride and in distilled water. Both solutions appeared to retain their potency about as long as did the ointments; i. e., they lost approximately 60 per cent after fourteen days. (The refrigerated samples retained practically all the original strength after four months.) Although Bigger [9] and others claimed that the antibacterial activity of penicillin is inhibited by human serum or blood, the final experiments involved the use of pooled human blood plasma and normal serum albunin (human). The use of the blood mediums was based on the uniformly good results I have obtained with the use of human blood (either plasma or whole blood) as a topical application in the treatment of corneal abrasions and ulcers. For the past four years this treatment has been under investigation by this author and found to be effective. In view of the avascularity of the cornea, and because many corneal diseases heal concomitantly with neovascularization, it was thought logical to provide blood elements directly to the lesion to assist in the healing process.[10] It was thus deemed worthy to combine the blood with penicillin in order to ascertain its synergistic or its antagonistic effects on stability.

METHOD OF EXAMINATION

The contents of 1 ampule of sodium penicillin was dissolved in 200 cc. of pooled human blood plasma to make a solution containing 500 units of penicillin per cubic centimeter. To the melted and cooled agar (brain, heart infusion) rabbit blood was added and well mixed and then allowed to solidify in a Petri dish. The agar was previously seeded with 0.1 cc. of a broth mixture of staphylococci containing approximately 1,200,000,000 organisms per cubic centimeter. A circular disk of heavy filter paper 2 cm. in diameter was saturated with the plasma-penicillin solution. It required 0.10 cc. of solution to saturate a disk of the size used. The disk of filter paper was placed in the center of the solidified agar surface. The zone of inhibition surrounding the disk was measured after twenty-four hours of incubation. The plasma-penicillin mixture was allowed to remain in a capped bottle in the room and was tested every five to seven days. Exactly the same procedure was followed using blood serum. The latter was obtained by using a preparation of concentrated normal serum albumin which comes in dry form and is mixed with a buffered diluent accompanying the package. One such

9. Bigger, J. W.: Inactivation of Penicillin by Serum, Lancet **2**:400-402 (Sept. 23) 1944.

10. Naide, M.: Treatment of Leg Ulcers with Blood and Concentrated Plasma, Am. J. M. Sc. **205**:489-493 (April) 1943.

package contains 25 Gm. of normal serum albumin and when diluted makes up 100 cc. of the solution.

Both the plasma and the serum penicillin mixture were tested three times, using the same brand of sodium penicillin.

It is significant that this experimentation took place during the months of April, May, June, July and August. Room temperatures during this period varied from 80 to 100 F.

The plasma mixture after a few days became turbid and contained flocculent material. From a dirty yellowish color, this flocculent material became successively grayish and then greenish. The appearance was that of contamination with mold. Some of the agar plates also showed contamination with green mold, which had the appearance of Penicillium notatum. Microscopic examination revealed that the constant con-

*Percentages of Potency Retained Based on Measurements of the Zone of Inhibition**

Interval, Days	Plasma Solution No. 1 (500 Units)	Plasma Solution No. 2 (1,000 Units)	Serum Solution (5,000 Units)
14	74%	92%	84%
28	66%	80%	79%
42	57%	76%	70%
55	48%	66%	60%
70	40%	62%	49%
84	27%	52%	37%
90	19%	47%	31%
100	Negligible	23%	20%
110	Negligible	Negligible	Negligible

* The zone of inhibition is measured in the fresh sample after twenty-four hours of incubation and is construed as indicating 100 per cent potency. Percentages are obtained by comparing subsequent measurements with the first one.

taminant was Penicillium. However, no means were available for further classification of this mold. All samples of the plasma-penicillin mixture seemed to produce some of this "contaminant."

The serum mixture remained a crystal clear yellow at all times. In none of the samples was there any semblance of turbidity.

Clinical use was made of both preparations, with the serum mixture as the favorite. When the latter was instilled in the cul-de-sac, the patient nearly always commented on the soothing sensation. Contact of the penicillin with the tissues was enhanced by the "stickiness" of the serum albumin on drying.

CONCLUSIONS

A study was made of the stability of various penicillin mixtures, allowed to remain at room temperature, which varied from 80 to 100 F., in a southern climate. Stability of sodium penicillin in isotonic solution of the sodium chloride and in distilled water was compared with the stability of mixtures in white ointment U. S. P. and Aquaphor ointment. All preparations tested contained 500 units of penicillin per cubic

centimeter or gram. It was found that the ointments remained potent as long as the solutions (water or solution of sodium chloride) but that the loss was rapid and wasteful. It was found that the use of the ointment forms was impractical from the patient's viewpoint, or is at least until such time as the ointment is made available in a collapsible ophthalmic tube. It is doubted whether the two ointments tested here can be used efficiently because their lasting power was not in any way remarkable. It is true, of course, that if greater concentrations of penicillin are used the effectiveness would be proportionately prolonged.

The stability of sodium penicillin in suspensions with cod liver oil and olive oil was compared with that of the drug in ointment and solution form. These suspensions proved more effective than either the ointments or the saline solutions, and the olive oil mixture was the more effective. After seventy days the mixture contained approximately 50 units per cubic centimeter. Inasmuch as penicillin is bacteriostatic for staphylococci in a concentration of only 0.08 unit per cubic centimeter, this old mixture can be said to be still "effective," if not efficient. It is believed that these suspensions need to be further studied and that these oils might in the future become ideal vehicles for sodium penicillin.

The stability of sodium penicillin in blood plasma and in human serum was studied and compared with the stability of the drug in other preparations. It would appear from this study that of all the mixtures tested these solutions gave the best results. This view is strengthened by the fact that room temperatures were approximately 20 F. higher during this portion of the investigation. It would appear that the presence of blood plasma enhanced the action of the penicillin rather than inhibited it. Of the two, the plasma solution appeared to be the more effective and the more stable. A solution containing 500 units per cubic centimeter often equaled in effect some of the preparations containing 1,000 units per cubic centimeter. It is believed that the increased stability of the penicillin-plasma solution might be due to spontaneous production of penicillin. Further study with this solution is indicated. The serum-penicillin solution, while not so effective as the plasma solution, nevertheless proved better than any of the ointments, oils or solutions.

The penicillin-serum solution was chosen for use at this institution because of its more consistent stability and its lack of turbidity and mold growth. The procedure at this hospital is to make up 1 ampule of sodium penicillin in solution of blood serum and dispense the material in 10 cc. quantities through the pharmacy on prescription. Although the 200 cc. that is made up at one time is dispensed within one week, the stock bottle is kept in the pharmacy refrigerator, so that each patient receives the full strength when starting treatment.

In general, clinical results have been good with all the penicillin mixtures when used in the treatment of properly selected patients and when applied frequently, in order to maintain contact with the tissues. Instillation every two hours is advisable as the minimum, and perhaps instillation every hour would be better.

It is believed that the most stable penicillin solution has not yet been discovered, but the variability of the many mixtures tested indicates that a step is being made in the proper direction. At this stage it is my opinion that penicillin solution as used here compares favorably in stability with many of the popular ophthalmic remedies, such as solutions of mild protein silver and physostigmine. The latter solutions are known not to remain "potent" nearly as long as does the penicillin solution and yet are in great repute.

238 West Wisconsin Avenue (3).

MARGINAL MYOTOMY

Analysis of Twenty-Two Cases

GLEN GREGORY GIBSON, M.D.
PHILADELPHIA

OPHTHALMOLOGISTS are in agreement about the value of careful refraction and full optical treatment in the management of concomitant strabismus. Beyond this, however, particularly in the field of surgery, one finds many schools of thought concerning the proper procedure in cases of this disorder. This is not surprising, however, since the etiology and pathology of strabismus remain partly unsettled. However, in spite of these and many other difficulties, gratifying progress in the correction of strabismus is being made. Nevertheless, the frequent occurrence of such undesirable conditions as amblyopia ex anopsia, subnormal binocular vision, incomplete corrections and postoperative overcorrection leaves much to be desired in the treatment of strabismus. In an attempt to decrease the incidence of these undesirable conditions, I have resorted to the use of marginal myotomy of the internal rectus muscles in some carefully selected cases during the past five years. Several similar operations and various modifications of this procedure are used by many ophthalmic surgeons, and no attempt is made in this paper to give credit to those who developed these various procedures. The idea of making the incisions well back in the belly of the muscle was advocated by Chavasse [1] in 1934, and my patients were selected and operated on in essentially the same manner as he described. This operation differs from a partial tenotomy in that it is performed posterior to the tendon, in the muscle, and consequently produces a much greater effect. Because of the careful selection, the number of patients in this series is necessarily small, but the material is adequate to demonstrate that this operation, like so many other surgical procedures, has desirable as well as undesirable features.

The simplicity of the operation and its safe applicability to young patients make this procedure a useful addition to one's surgical armamentarium. The operation consists in two vertical incisions in each internal rectus muscle. The two incisions are placed in the margins of the muscle directly opposite each other, in such a manner that they do not meet in the center, so as to leave a central band of intact muscle (fig. 1).

Read at the Eighty-First Annual Meeting of the American Ophthalmological Society, Hot Springs, Va., Nov. 13, 1945.

1. Chavasse, B.: Tr. Ophth. Soc. U. Kingdom **54**:506, 1934; Worth's Squint or the Binocular Reflexes and the Treatment of Strabismus, Philadelphia, P. Blakiston's Son & Co., 1939.

The technic of the operation consists in freely exposing the internal rectus muscle. A Prince forceps is placed across the body of the muscle, at right angles to the muscle fibers, as far posterior to the tendon as possible. The two incisions are made close to and parallel with the blades of the Prince forceps directly opposite each other so as to cut all but the central 2 to 3 mm. of muscle. The amount of muscle which is left might seem inadequate but actually is not, as neither the rotational nor the convergence function of the internal rectus muscle was impaired. The incisions are made in a series of small snips so that the two incisions will be of equal length, in order that the remaining fibers will be in the center of the muscle. Each incision is about 3 mm. in length. No sutures are placed in the muscle, and the conjunctiva is closed. Hemorrhage is more profuse than in other muscle operations.

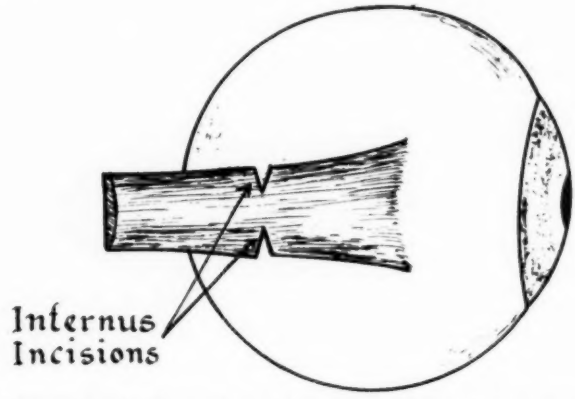


Fig. 1.—Diagrammatic illustration of the two incisions situated well back in the body of the rectus internus muscle.

The object of the marginal myotomy is to decrease the action of a hyperactive muscle. The operation was used in cases in which bilateral recession of the internal rectus was thought to be too extensive a procedure. After this operation the hyperaction of these muscles is no longer manifest and the eyes usually become straightened immediately. Since in most cases this operation was performed at an age before amblyopia ex anopsia had become permanently established, it was hoped that the patients would acquire normal binocular vision and that the eyes would remain straight. Actually, this ideal result of normal vision in each eye, normal binocular vision, and relief from strabismus was achieved in only 6 of the 22 cases representing our series to date.

From the standpoint of this operation, cases of strabismus fall into one of three, not too accurately defined, groups, namely: suitable cases, unsuitable cases and cases which may be made suitable by preoperative treatment. The cases which are classified as suitable are those in which

the strabismus is of short duration and the amount not too great and cases in which the strabismus is of the early alternating and symmetric type, particularly if the refractive error is relatively low. Cases which fall in the unsuitable group are those in which the strabismus is of higher degree and of longer duration, cases of profound monocular squint, cases in which the subject is past 7 or 8 years and all cases of divergent strabismus. The cases which may be made suitable for this operation are those in which the patient is under 6 years of age and the strabismus, with the use of glasses or occlusion can be converted into an alternating type. The group of cases which is hereby classified as suitable for this operation is open to the objection that in some of them the condition may be corrected by a nonsurgical method. While this objection may be partly justified, it is not entirely sound, since in waiting the time may come when it is too late to obtain normal binocular vision.

The cases which can be made suitable for operation are those in which total and complete alternating occlusion is used until the strabismus becomes freely alternating. The purpose of this alternation is to develop the monocular retinal function to a point where it is equal to that of its fellow eye, in order that the eyes may be of equal assistance in maintaining parallelism after they have been straightened by operation. If this preoperative precaution is not taken, the chances of obtaining a satisfactory result with this operation are rather remote.

ANALYSIS OF CASES

The material for this report consisted of 22 patients with convergent strabismus who were operated on at Temple University Hospital and have been followed from one to four years after the operation. All but 5 of these patients were under 6 years of age at the time of operation; the average duration of their strabismus from the onset until the operation was only fourteen months. This shows that an attempt was made to use this procedure in cases in which the strabismus was of relatively short duration. The age of onset of strabismus was 2 years or younger in 15 of these patients, indicating that the procedure was not frequently used in cases of typical accommodative strabismus, the onset of which usually occurs at about 3 years of age. Full correction glasses had been worn by 20 of the 22 patients for at least six months prior to operation. If no improvement in the angle of deviation was demonstrable after about six months of the optical treatment, further reliance on this type of treatment was usually discontinued. The refractive errors in the two eyes were essentially equal with respect to the amount of hyperopia or astigmatism in 20 of the 22 cases, indicating that an attempt was made to subject patients with symmetric strabismus to this procedure. There were 2 patients with slight anisometropia in the group. In 10 of the patients the refractive error was less than 2 D. of hyperopia, and in only 3 patients was the refractive error higher than 4 D. of hyperopia. There were no cases of myopia in this series.

Further evidence of the symmetry of the strabismus in the selected cases was available in the ocular rotations. Eighteen of the patients were recorded as having equal amounts of excessive action of both rectus internus muscles. No patients were included who showed a definite unilateral preponderance of abnormal

rotation in one eye as compared with that in the fellow eye. Patients with typical monocular strabismus were subjected to different types of surgical procedures. Likewise, patients who had high degrees of strabismus or patients with long-standing strabismus were subjected to more extensive types of operation.

Nineteen of the patients had 30 degrees of strabismus or less, and in a number of these patients the strabismus was variable in amount. That is, since many of the patients had strabismus of relatively short duration, the degree of strabismus had not become established at a constant figure at the time of operation. Six of the patients had partial amblyopia ex anopsia which was not completely overcome by what was considered an adequate period of occlusion.

Twenty-one of the 22 patients had a bilateral marginal myotomy. In the 1 patient a unilateral marginal myotomy was performed. The operation takes little time, is easily performed and requires only a few days of hospitalization. There were no complications in the series, and only 1 patient had to have a second operation. There was only 1 instance of postoperative divergence in the series, and in that case the complication was overcome in a few months, without further treatment.

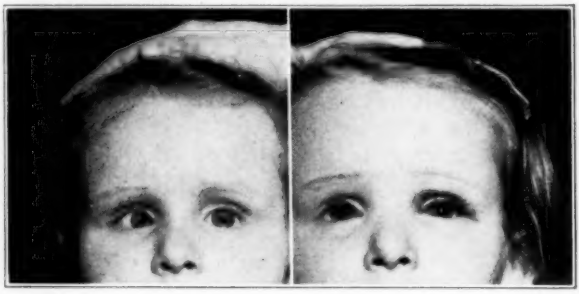


Fig. 2.—Preoperative and postoperative photographs of a patient who had binocular vision after operation and whose eyes remained straight.

An illustrative case is that of D. C. (fig. 2), aged 2 years 9 months, whose mother stated that for the past month the right eye had turned in, at first intermittently and later constantly. The right eye had 10 degrees of convergence, which increased considerably when the eyes were forcibly converged. Fixation was accurate with each eye. The rotation showed a 1 plus overaction of the right rectus internus. On refraction, she was found to have 1.50 D. of hyperopia in each eye. Occlusion was ordered, and in three days the left eye became convergent and the right one was straight. One month later she presented the picture of typical alternating concomitant convergent strabismus. The strabismus was 15 degrees, and + 1.50 D. spheres were ordered. After three days of wearing the glasses the eyes became straight. The eyes remained straight for about a month, when the convergent strabismus again became manifest at 20 degrees with the glasses on. Atropinization and occlusion were again ordered to maintain alternation. Five months after the first visit the strabismus had become 30 degrees, and the action of both rectus internus muscles was 2 plus. Seven months from the time the patient was first seen a bilateral marginal myotomy was performed. The eyes were straight on the first postoperative day and have remained straight for five years. Six weeks after operation she had fusion, and at the present time she has normal binocular vision; the only residual evidence of her strabismus is the slight conjunctival scars.

Figure 3 illustrates the preoperative distribution of strabismus in the 22 patients.

The immediate results were gratifying, as 20 of the patients were recorded as having straight eyes at the time of their first visit after hospitalization (fig. 4). Almost all the patients had normal rotations

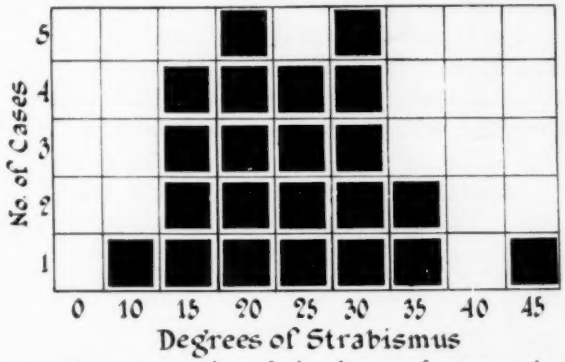


Fig. 3.—Graphic representation of the degree of preoperative strabismus in each of the 22 cases studied.

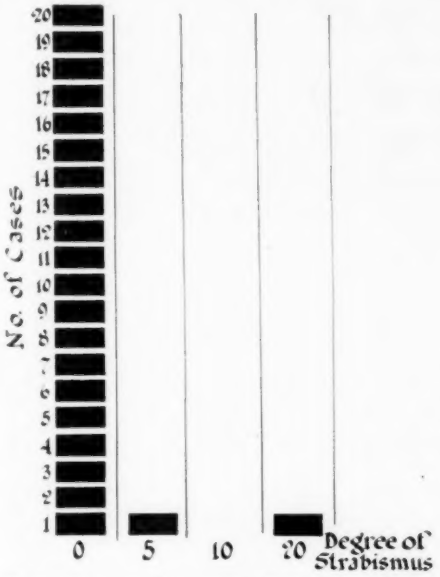


Fig. 4.—Immediate postoperative result, illustrating the notable improvement in the series.

after the operation. The overaction of the rectus internus muscles was almost uniformly relieved, and there was no case of subnormal rotation of the eyeball in the field of the muscle operated on. None of the patients had demonstrable fusion at the first postoperative visit. Two of the patients attained fusion in about three months after the operation

and 4 in about one year. The method gave good results in 2 patients whose eyes were straight when wearing glasses but converged freely without glasses. In these patients the eyes remained straight without glasses after the operation. When the records were reviewed, at periods varying from one to four years after operation, it was found that the eyes of only 8 of the patients remained perfectly straight and that 12 were found to have from 5 to 10 degrees of residual or recurrent strabismus (fig. 5). While this amount of recurrent strabismus was disappointing from the standpoint of the patient's acquiring normal binocular vision, it is consistent with the teaching of Bielschowsky,[2] who stated that "a small deviation of 5 degrees must be left, particularly if the patients are young children, since a spontaneous decrease in convergence is to be expected." The amount of strabismus which was present in the patients who had recurrences was always considerably less than the

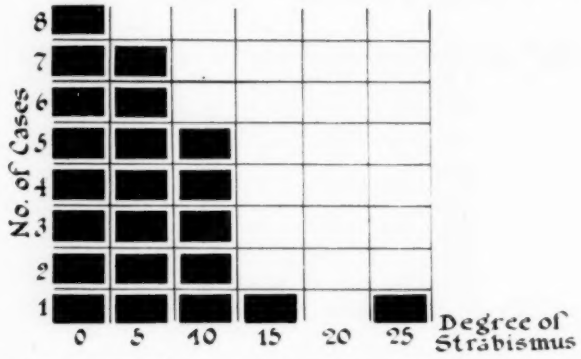


Fig. 5.—Late postoperative results (one to four years), illustrating the tendency to recurrence.

amount which they originally had, as can be seen by comparing figures 2 and 4. Several of the patients had their eyes straight for two to three years after the operation, before the strabismus recurred. It would seem that the incidence of recurrence after operation is too high, particularly in view of the fact that most of the cases were favorable.

A case which illustrates the tendency to recurrence is that of C. H. (fig. 6), aged 2 years 9 months, who had had 12 degrees of concomitant convergent strabismus for two months when first examined. The rectus internus muscles were recorded as being equally hyperactive. The refractive error was corrected with a + 1.00 D. sphere combined with a + 0.50 D. cylinder for each eye. The fixation was accurate and equal in the two eyes. Six months later, the left eye turned more than the right and occlusion was ordered. After two months of alternate occlusion, his eyes were freely alternating, and a bilateral marginal myotomy was performed. On the first postoperative visit, the eyes were straight and the rotations were normal. Three months later the left eye turned in 8 degrees at various times. He had no fusion, and occlusion was again resorted to, at the age of 5, because the left eye had become amblyopic. Two years after the operation the eyes turned in 10 degrees without

2. Bielschowsky, A.: Am. J. Ophth. **22**:145, 1939.

glasses and 8 degrees with them. The vision was equal in each eye. No fusion was demonstrable.

In considering the possible reasons for recurrences in this series of patients, it would seem that amblyopia ex anopsia was the most apparent single cause. Five of the 6 patients with amblyopia had permanent recurrence of strabismus, and the sixth patient had a recurrence which lasted over a year before the eye became straight. In 2 of the patients the recurrence might possibly be explained by the strabismus being of too long a duration. Two of the recurrences were attributed to the refractive error being relatively too high. One recurrence was attributed to the amount of strabismus, of 45 degrees, being too much to be overcome by this operation. In 3 of the patients no obvious cause for the recurrence was found. One gets the impression from the review of the

Fig. 6.—Preoperative and postoperative photographs of patient whose eyes were straightened and who subsequently had a recurrence.

cases in which recurrences developed that the important factors which cause failure are defects in the sensory function of the ocular mechanism, rather than the motor abnormalities. The operation was very successful in overcoming the hyperactive rotations even in cases in which recurrence developed. It is possible that more careful attention to the sensory aspects of these cases after operation may have decreased the incidence of residual strabismus in this series. None of the patients had orthoptic treatment.

SUMMARY

The operation of marginal myotomy is useful in certain types of strabismus. It is most helpful in those cases in which bilateral recession might result in a postoperative divergence. In order to avoid the rather high incidence of recurrence, it is necessary to exercise great care in the selection of the cases for this operation.

255 South Seventeenth Street (3).

THE CAPILLARY SPHINCTER IN THE HUMAN RETINA

JOHN N. EVANS, M.D.
BROOKLYN

STUDIES of the blood vessels of the human retina were primarily stimulated by interest in the anatomy of the structures of the eye-ground as they relate to basic aspects of ophthalmoscopy. The paucity of information to be gathered from the literature on the histology of the retinal vascular system made it necessary to undertake investigations of surface preparations of the choroid and the retina.

A number of these preparations were stained with a great variety of agents before an occasional satisfactory one was obtained. Most of the material was obtained from eyes enucleated for the usual clinical indications. The retinal preparations found most useful were those stained with Weigert's stain for elastic tissue without counterstain. Fixation was with dilute solution of formaldehyde U. S. P. The best preparations of the choroid were those stained with Mallory's aniline blue. The retina or the choroid was stripped from the underlying layer. In some instances the choroid was bleached. In others this was unnecessary. The tissue was cleared with xylol, stained and mounted on a slide with a cover glass in the usual manner. Those preparations which were selected as satisfactory were more instructive than any previously seen or found reported in the literature. This was demonstrated by the sharply defined details which could be brought out by photomicrography. During the study of these preparations a peculiar abrupt narrowing of certain capillaries was noted where they joined the vessel of the next larger order. This seemed to be a unique discovery, the correct interpretation of which was of the utmost importance.

One had to consider three possibilities, namely that the pinching was (1) an artefact, (2) a pathologic change or (3) the indication of a normal histologic structure.

Though none of these possibilities could be definitely accepted or discarded, the existence of an artefact at that particular place seemed unlikely in the absence of similar changes elsewhere in the capillaries. Higher magnification showed no change at the junction of the capillary and the larger vessel which could be interpreted as pathologic. One therefore had to incline to the view that this narrowing was of a purely histologic nature and that it might be due to a sphincter-like action in

From the Department of Ophthalmology, Long Island College of Medicine.

Fig. 1.—Surface preparation of the entire thickness of the retina, except for the pigment epithelium, from the neighborhood of the equator of the eye. The arrows indicate the constrictions where the capillaries join the vessel of the next larger order.

This photograph and those in the accompanying figures have not been retouched. Weigert's elastic tissue stain without counterstain; magnification, × 160.

Fig. 2.—One of the regions of junction, showing narrowing. With the immersion lens, a plump, nucleus-like body was seen at the point of each arrow. It was not possible to bring this out in the photograph.

The preparation and staining were the same as those used in figure 1. Magnification, × 880.

this region, because some capillaries did not show this narrowing at the junction with the larger vessel.

All the available ophthalmologic literature on retinal vessels was reviewed, without disclosing a similar description. At this point, the work of Chambers and Zweifach [1] and of others [2] was called to my attention. These investigators, whose contributions are widely recognized, had described a narrowing at the junction identical with that described here which they observed in the capillaries of the bat's wing and of the mesentery of the rat and dog.[3] Moreover, they had seen the region contract and dilate with sphincter-like effect and had secured satisfactory photographs. Their observations made more reasonable my postulation of the presence of a sphincter-like structure in the capillaries of the retina. Their paper is comprehensive in the field of capillary circulation and should be read in full.

Unfortunately, the living human eye does not lend itself to experiments such as those the anatomists were able to perform on animals. Thus far, the slit lamp has not demonstrated similar junction constrictions in the epibulbar tissues of the human eye. The constriction has not been observed with the ophthalmoscope.

Possible dilatations and constrictions of capillaries by pressure reflected from the larger vessels has long been recognized. A muscle-like constricting effect of the Rouget cells was described by Krough, but his work of late years has been seriously questioned by other authors.[4] Some investigators [4] expressed the belief that the nuclei of endothelial cells could swell sufficiently to occlude the lumen, thus causing a back pressure which would dilate the capillary.

Figure 3 shows narrowing at the junction of the choroidal vessels. If retinal and choroidal capillary sphincters do exist, their contraction would have a powerful effect on the capillary bed. The sphincters at the junction with the arterioles would decrease the area of the capillary bed; those at the junction with the venules would cause stasis and increase the area of the bed. It is conceivable that a derangement of this sphincter mechanism by disturbance of the sympathetic hormonal relations might be a factor in producing a type of glaucoma simplex.

1. Chambers, R., and Zweifach, B. W.: Topography and Function of the Mesenteric Capillary Circulation, Am. J. Anat. **75**:173 (Sept.) 1944.

2. Tannenberg, J.: Bau und Funktion der Blutkapillaren, Frankfurt. Ztschr. f. Path. **34**:1, 1926.

3. Tannenberg [2] is said to have observed precapillary sphincters in fixed preparations of the mammalian eye, but I have been unable to locate the specific article in which he reported this observation.

4. Wiggers, C. J.: Physiology in Health and Disease, ed. 4, Philadelphia, Lea & Febiger, 1944, p. 547.

Fig. 3.—Surface preparation of the choroid, which was stripped from the underlying layer and bleached. Arrows indicate narrowing at the junction of the smaller vessels with those of the next larger order.

Mallory's aniline blue stain for collagen; magnification, × 160.

Fig. 4.—Surface preparation of the retina from an eye removed for absolute glaucoma simplex. There is a dense constriction where dilated capillaries merge with vessels of the next larger order, whereas other capillaries coming off the same larger vessel show no such constriction or aneurysmal dilatations. Branches from the dilated vessel seem to have been protected from changes in transmitted pressure, as though their own mechanism was adapted for this purpose. Had a weakness originated in the capillarly wall, one might expect that all the capillaries in this region would be similarly affected.

Weigert's elastic tissue stain; magnification, × 140.

If this meager evidence is ultimately supported by better substantiated studies, it would seem reasonable to conclude that the retinal capillary aneurysms associated with glaucoma, such as those shown in the surface preparation of the retina (fig. 4) from a case of absolute glaucoma simplex, may have had their origin in a prolonged constriction of the sphincter muscle. I have been able to find this picture of capillary aneurysm in some area of the retina of a number of eyes removed in the last stages of glaucoma. The patients from whom these eyes were removed did not have diabetes mellitus. I emphasize this fact in view of the reported [5] occurrence of capillary aneurysm in cases of diabetes mellitus.

There is perhaps further significance in the fact that Chambers and Zweifach [1] studied the active responses of this region of junction through the application of high dilutions of epinephrine and histamine.

23 Schermerhorn Street (2).

5. Ballantyne, A. J., and Loewenstein, A.: Retinal Micro Aneurysms and Punctate Haemorrhages, Brit. J. Ophth. **28**:593 (Dec.) 1944.

REMOVAL OF DEEPLY EMBEDDED FOREIGN BODIES FROM THE CORNEA

SIDNEY A. FOX, M.D.
NEW YORK

CORNEAL foreign bodies lying close to Descemet's membrane always present a problem. When the eye involved is the patient's only good eye, the necessity for careful surgical handling is proportionately greater. During the past year, 6 deeply embedded corneal foreign bodies requiring removal were seen at this Army ophthalmic center. These foreign bodies were all in eyes with normal vision or with vision correctable to normal. Two of the patients were monocular. A third had only perception of hand movements in the other eye. In a fourth patient the other eye was aphakic, with a corrected vision of 20/70. Two patients had good vision in both eyes.

All the patients were battle casualties, and the foreign bodies were all metallic. Three were found to be magnetic after removal. In this connection, I should like to state, however, that even if the foreign body is magnetic the magnet is useless in removal of these deeply embedded foreign bodies from the cornea until they have been loosened from the surrounding stroma.

REPORT OF CASES

The first case encountered was that of a monocular patient. The foreign body was just below the corneal apex (fig. 2, case 1) and was surrounded by a rust stain, which involved the pupillary area. The body was irregular in shape, and examination with the slit lamp showed that it lay in the posterior third of the corneal stroma. The temptation to leave the eye alone was great. However, since the rust stain was obviously spreading and the eye was irritable, it was felt that this could not be done. The following technic was adopted and carried out.

The pupil was widely dilated with atropine. Corneal anesthesia was obtained by instillation of 0.5 per cent tetracaine hydrochloride. With a Ziegler discission knife, a corneal flap was fashioned by means of two incisions meeting at an apex (fig. 1*a*, lines *BA* and *BC*) pointing toward the center of the cornea and containing the foreign body between them. The incisions were beveled toward each other, so as to approach the foreign body more closely (fig. 1*b*). After sufficient depth had been attained, the corneal flap was folded back on its base (fig. 1*c*, line *AC*), and the foreign body was exposed. This was then gently

From the Eye Center, Newton D. Baker General Hospital, Martinsburg, W. Va.

freed from the surrounding stroma with the point of the knife and lifted out. The rust stain was carefully curetted away and the corneal flap patted back into place with a spatula. No sutures were necessary. Atropine was instilled and the eye patched. The cornea was completely healed and the patch removed in four days.

In 5 additional cases this technic was subsequently used. The details are given in the following brief case histories.

CASE 1.—Pvt. R. L. H. was wounded on May 29, 1944 at Veretro, Italy, by fragments of a German mortar shell, sustaining wounds of both eyes, the skull and the right wrist. The left eye was enucleated the same day. When he

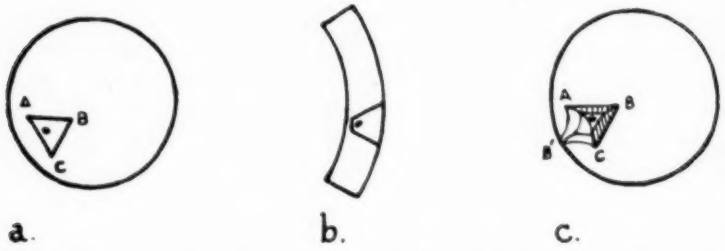


Fig. 1.—Diagrammatic scheme of corneal flap technic. (*a*) The cornea is incised along lines *BA* and *BC* and not along line *AC*. (*b*) The incisions are beveled toward each other. (*c*) The flap *AB'C* is then turned back to expose the foreign body. After extraction, the flap is patted back into place with a spatula.

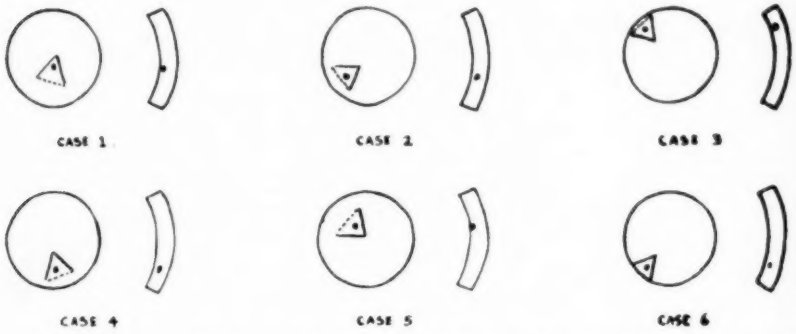


Fig. 2.—Approximate position of the foreign bodies in each of the 6 cases reported. No attempt has been made to depict the exact size and shape of the corneal foreign bodies.

was admitted to this hospital, vision in the right eye was 20/30, correctable to 20/25. The bulb showed a faint ciliary flush. Examination with the slit lamp disclosed a deeply embedded foreign body just below the corneal apex, which was surrounded by a rust stain (fig. 2, case 1). The aqueous showed a faint flare and a few cells. There was a small posterior cortical opacity of the lens at 10 o'clock, and the vitreous showed a few fine stringy opacities. Fundoscopic examination revealed nothing abnormal. On Sept. 15, 1944, the

foreign body was removed through a corneal flap, as previously described. Healing was uneventful. On September 18 the cornea no longer stained, and patching was discontinued. The flare persisted, however, and the patient was placed under treatment with atropine and application of hot compresses three times a day. On September 27 the anterior chamber was clear and medication was discontinued. Since plastic surgery of the left lids and socket was required, the patient was under observation until July 3, 1945. At this time the eye was completely white and quiet. A faint corneal nebula still marked the original site of the foreign body. The media and fundus were unchanged. Vision was 20/20, with ability to read Jaeger type 1.

CASE 2.—Pfc. A. M. was wounded on July 21, 1944 at Cherbourg, France, by an enemy hand grenade. Fragments entered both his eyes, amputated his right middle finger and lacerated both his thighs. After first-aid treatment, he was evacuated to England, where "fragments of metal were removed from both his eyes." On his admission to this hospital, vision was limited to perception of hand movements at 1 foot (30 cm.) in the right eye and was 20/40 — 1, correctable to 20/25, in the left eye. Both eyes showed multiple corneal maculas. The right eye had traumatic iritis with ragged atrophic iris and posterior synechias. There was also a traumatic cataract. The left eye showed a faint circumcorneal flush and a deeply embedded corneal foreign body (fig. 2, case 2). The anterior chamber showed a faint flare. The lens, vitreous and fundus were normal. Treatment for the bilateral iritis was instituted, and both eyes responded well. On Nov. 28, 1944 the foreign body in the left cornea was removed through a corneal flap. The cornea was healed on December 2. On December 10 all medication was discontinued. The patient was last seen on Feb. 2, 1945, at which time both eyes were white and quiet. Vision was limited to perception of hand movements at 2 feet (60 cm.) in the right eye and was 20/25, correctable to 20/20 — 2, in the left eye.

CASE 3.—Cpl. G. W. was wounded near Cherbourg, France, on July 26, 1944 by fragments from an 88 mm. enemy shell. He sustained a fractured skull and wounds of the left eye and left foot. He was evacuated to England, where (he stated) a foreign body was removed from his left eye on August 18. On his admission to this hospital, corrected vision was 20/20 in each eye. The right eye was entirely normal. The left eye showed mild iritis with a deeply embedded foreign body in the cornea (fig. 2, case 3). On Jan. 16, 1945, the foreign body was removed through a corneal flap. On January 19 the cornea was clear and the iritis had subsided. The patient was last seen on May 15, 1945, at which time both eyes were normal and vision was 20/20 in each eye.

CASE 4.—Sgt. E. E. L. was wounded on Jan. 9, 1945, in Belgium by a Teller mine and received multiple wounds of the face, the left hand and the right thigh. On his admission to this hospital, vision was 20/50 in the right eye and 20/40 — 2 in the left eye. Both eyes showed numerous conjunctival powder burns and superficial corneal opacities. Both anterior chambers were clear, but the irises were irregular and reacted poorly to light. The right cornea showed a deeply embedded foreign body, surrounded by a greenish rust stain (fig. 2, case 4). The media and fundi were normal. On April 3 the foreign body was removed through a corneal flap. Patching was discontinued on April 10. On June 28 vision was 20/50 in the right eye and 20/30 —2 in the left eye. The reduction in vision was attributed to the corneal opacities.

CASE 5.—Pvt. E. R. C. was injured in Germany on March 31, 1945 by shell fragments, sustaining wounds of both eyes and the left foot. On his admission to the hospital, vision was 20/25 in the right eye and 20/300, correctable to 20/70, in the left eye. Both eyes showed multiple superficial corneal opacities, with one deeply embedded corneal foreign body in the right eye (fig. 2, case 5). There was a slight posterior displacement of Descemet's membrane at this point. There was also mild iritis, but no other pathologic condition. The left eye showed a partial anterior capsular and subcapsular traumatic cataract, which was apparently stationary. On July 10 the corneal foreign body was removed through a corneal flap. On separation of the foreign body from its position, a drop of aqueous slowly formed in the corneal wound. There was no tendency for the iris to prolapse. The corneal flap was patted into position, the eye patched and a supportive bandage applied. The following day the anterior chamber was reformed. Patching was discontinued on July 13, and on July 16 the eye was completely healed and white. On July 23 vision was 20/25 in the right eye and 20/70 in the left eye.

CASE 6.—T/5 R. D. M. was wounded by shrapnel in Italy on April 10, 1945, sustaining injuries of both eyes. The left eye had to be enucleated six weeks later. On his admission to the hospital vision in the right eye was 20/25, correctable to 20/20. Examination with the slit lamp revealed a deeply embedded corneal foreign body (fig. 2, case 6) near the posterior surface, surrounded by a halo of rust. A faint flare and a few cells were visible in the anterior chamber. On September 20 the foreign body was removed through a corneal flap and the rust stain curetted. The cornea was healed on September 22. On September 27 vision was 20/20 with correction.

COMMENT

It will be noted that in 1 case (case 5) aqueous was lost after removal of the foreign body, which protruded slightly into the anterior chamber. Closure of the corneal flap and supportive dressing resulted in restoration of the anterior chamber in twenty-four hours and uneventful healing, as in the other cases. In all 6 cases the cornea was healed within four days or less. Clean incision of the cornea, instead of "picking" at it, results in less mutilation of corneal stroma, and consequently less corneal opacification. If the cornea should be penetrated, as it was in case 5, the flap is an efficient valve with which the anterior chamber can be sealed off instantly, and it heals in rapidly.

Other precautions are, of course, necessary. One always has to decide what to do with the iris. In cases 1 and 5, in which there was a centrally placed foreign body, the pupil was dilated. In cases 2, 3, 4 and 6, in which the foreign bodies were more peripheral—the pupil was contracted with physostigmine. The purpose was to prevent a prolapse of the iris in case of corneal perforation and sudden loss of aqueous. Experience in case 5, however, showed that loss of aqueous is negligible and that there is no sudden gush outward, as with a keratome incision. Hence it is probable that the iris would

not have prolapsed in any case. This situation is due to the fact that the corneal penetration is minute.

To me, a much more important consideration is loss of the foreign body into the anterior chamber. Fortunately, this did not happen. But no procedure is fool proof, and the possibility must always be kept in mind. Since with this method prolapse of the iris is not a factor, it is probably better to contract the pupil in every case and use the iris as a protective curtain for the lens. Then, in case of accident, the foreign body could be extracted through a keratome incision with forceps or, if magnetic, with a hand magnet, with least danger to the lens.

63 East Seventy-Fifth Street (21).

NEW MODIFICATION OF THE McREYNOLDS TRANSPLANTATION FOR PTERYGIUM

LIEUTENANT COLONEL J. GOLDSMITH
MEDICAL CORPS, ARMY OF THE UNITED STATES

DURING the past three years an increasing number of recurring pterygiums have been observed in the Army following the classic McReynolds transplantation.[1] These failures have also been noted in civilian life. It is the purpose of this paper to offer an explanation for these recurrences and to present a new modification of the McReynolds procedure for their prevention. This method has been employed in 300 cases, with satisfying results.

A brief review of the anatomic framework of the ocular structures involved in the operation for pterygium will prove helpful in the discussion pertaining to the factors which are probably responsible for recurrences.

The subconjunctiva is divided into the superficial and the deep fibrous layer. The superficial layer consists of adenoid tissue, which is loosely arranged. The deep fibrous layer is the one more properly considered the subconjunctival connective tissue layer, rather than a constituent of the conjunctiva itself. It consists of a thick meshwork of collagenous and elastic fibers. Situated below this tissue is Tenon's capsule, that layer immediately surrounding the eyeball in the orbit. This layer thins almost to microscopic thickness as it approaches the limbus. Beneath Tenon's capsule is the episcleral tissue, which consists of a looser structure than the sclera proper; its bundles are more delicate and more tortuous and course in varying directions (Salzmann[2]). Outwardly, it extends into the loose tissue which fills out Tenon's space. Toward the inner side the bundles are firmer and thicker, and the mattressing is closer. In this way, the episclera graduates into the tissue of the sclera proper.

For facilitation of discussion, the McReynolds operation will be divided into the corneal and the conjunctival stage. The complete removal of the head of the pterygium, which has infiltrated and destroyed Bowman's membrane and the superficial corneal lamellas, depends on

---

From the Eye Clinic, Battey General Hospital, Rome, Ga.

1. McReynolds, J. O.: Pterygium Operation, Tr. Sect. Ophth., A. M. A., 1924, p. 27.

2. Salzmann, M.: Anatomy and Histology of the Human Eyeball, Chicago, University of Chicago Press, 1912.

a painstaking dissection. Not infrequently one observes partial ablation of the head. The neck is grasped and lifted with a fixation forceps, placing the head under moderate traction. The dissection should commence, preferably, at 0.5 to 1 mm. beyond the periphery of the infiltrating zone, as observed by slit lamp microscopy. The dissection is brought down to the most superficial layers of the substantia propia and the head completely removed in this plane. This microscopic dissection is accomplished with the aid of a binocular loupe. The magnification thus achieved greatly facilitates the accuracy of the dissection, the aim of which is to render the corneal and limbal sites completely free of residual tissue, so that cauterization will not be necessary. The denuded corneal bed and its edges will occasionally require curettement.

The inherent elasticity of the adhering bulbar conjunctiva along the superior margin of the body and the intrinsic retractility (due to shrinkage of the conjunctiva) of the stretched and tensed pterygium are important factors in disengaging the head from its transplanted site, since it is invariably held insecurely in the subconjunctival tissue.

In the McReynolds operation, the sutures are passed blindly through the loose subconjunctival tissue to emerge from the conjunctiva. The looseness of the subconjunctival tissue does not predispose to firm adhesions with the head of the pterygium. When the black silk sutures are removed on the third to the fifth day after operation, part of the forming adhesion is usually disturbed and broken; and if the retraction pull of the pterygium is sufficiently powerful, it is not long before the neck and the head of the retracted pterygium aline themselves in the horizontal meridian to commence invasion of the cornea again.

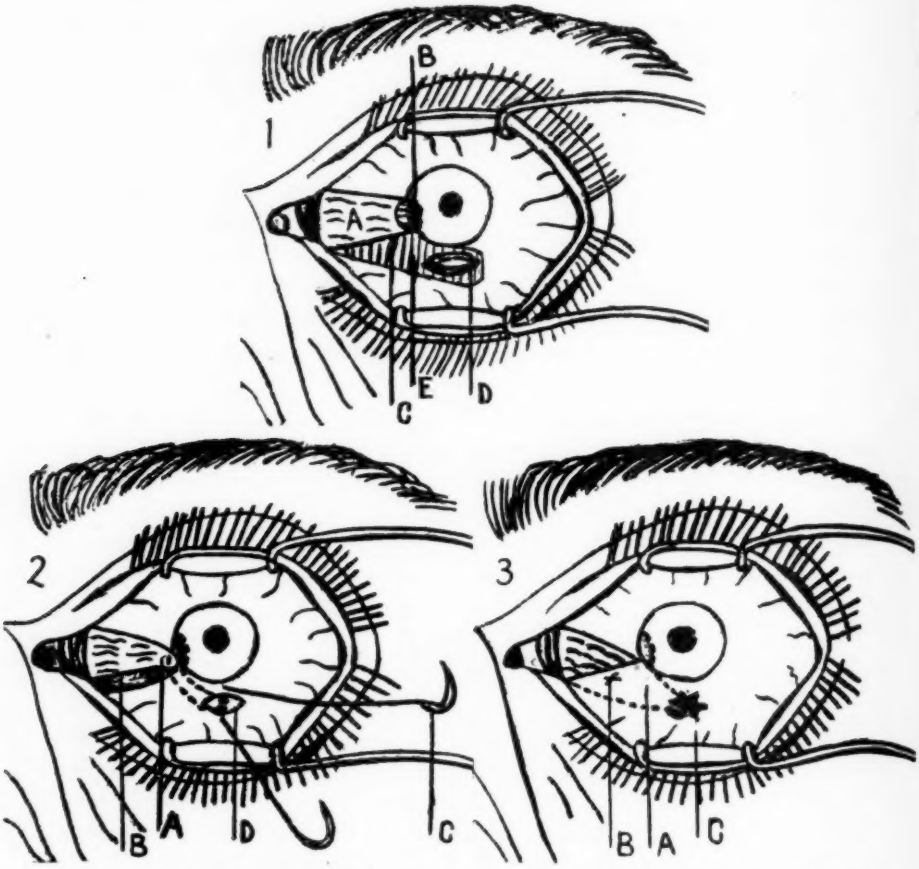
MODIFICATION OF THE MC REYNOLDS TRANSPLANT OPERATION

The head of the pterygium is removed from the cornea as previously described, and the inferior margin of the neck and body of the pterygium is severed from the bulbar conjunctiva toward the canthus for a distance of from ¼ to ½ inch (0.63 to 1.27 cm.). The pterygium is then separated by blunt dissection from the subconjunctival tissue and a double-armed, atraumatic, 0000 chromic surgical gut suture is introduced from without inward through the head of the pterygium. Chromic surgical gut is employed for two reasons: 1. Since removal of chromic surgical gut sutures is unnecessary, manipulation is therefore avoided, and the production of a firm scar is thus assured. 2. The chemical irritation which is produced by the liberation of chromic acid about the suture is an additional factor in securing a relatively firm adhesion between the head and neck of the pterygium and the episcleral tissue.

The bulbar conjunctiva below is undermined toward 6 o'clock in a narrow strip, measuring 4 to 5 mm., thus causing a minimal disturbance

of the lymphatic drainage in this area (figure, *1*). A number of surgeons undermine a large area, but this is unnecessary.

An incision 5 mm. in length, concentric with the limbal curvature, is made into the bulbar conjunctiva and Tenon's capsule and is placed 5 mm. from the limbus. The site for incision is previously gaged by grasping the head and placing it on the bulbar conjunctiva, after exert-



1, Narrow subconjunctival tunnel, *E*, leading to incision below, *D*. *A* is the pterygium; *B*, the denuded corneal bed, and *C*, the inferior margin of the pterygium. *2*, chronic surgical gut suture, *C*, passed through the episclera, *D*, under direct observation; a mattress suture is placed in the pterygium, *A*; *B* is the episcleral site of the traction suture. *3*, the head of the buried pterygium, *A*, is firmly united to the episclera and the conjunctiva in one suture, *C*; *B* is a traction suture.

ing a moderate pull on the pterygium. The inferior and superior edges of this incision are undermined for 2 to 3 mm. The previously prepared narrow subconjunctival tunnel, as described, is made to communicate with the conjunctival incision below. The heels of the two needles

are brought through the tunnel to emerge in the incision. The bulbar conjunctiva is grasped with a fixation forceps and the eyeball held firmly for counterpressure. The inferior lip of the conjunctival incision is retracted downward, and the inferior needle is passed through episcleral tissue and Tenon's capsule under direct observation (figure, *2*). A similar procedure is performed superiorly. A distance of 3 mm. should separate the two episcleral bites, vertically. The suturing is completed after the two needles have passed through corresponding sites in the free edges of the incision. The head of the pterygium is then drawn through the tunnel and the suture tied firmly. Thus, only one suture is required to unite all the tissues (figure, 3). In employing the procedure as described, the chances of recurrence are reduced to a minimum. One need not employ the conjunctival suture, as described, for very small pterygiums. After the body of the pterygium has been cut and a small subconjunctival tunnel made below, an assistant grasps and retracts the inferior conjunctival lip, so that an episcleral bite can be obtained under close observation.

It is advisable to employ a traction suture if excessive tension on the head of the pterygium is anticipated. This is accomplished in the following manner: The body is drawn upward after dissection of its inferior margin, bringing the underlying tissues into view. A small incision, measuring 4 mm., is made into Tenon's capsule; it lies perpendicular to, and 5 mm. away from, the limbus. The line of incision parallels the inferior border of the pterygium. A double-armed, atraumatic, 0000 black silk suture is passed through the episcleral tissue so that the bites are separated for a distance of 4 mm. By placing the pterygium on stretch, one can determine the exact location for the passage of the underlying suture. The needles are then introduced into the free edge of the conjunctiva and the suture is tied. This suture fixes the middle of the body and produces relaxation of the tension on the head of the pterygium. If the pterygium is very large and broad, one may use two traction sutures to great advantage. The sutures are removed on the fifth to the seventh day. If one desires to retain these sutures for large pterygiums, chromic surgical gut is substituted for black silk.

The redness of the conjunctiva persists from seven to ten days after the operation but is rarely associated with actual pain. In a small percentage of cases there is slight ocular discomfort, which has never been sufficiently pronounced to necessitate additional treatment. It is common to encounter a degree of bulbar injection in excess of that seen in the conventional McReynolds procedure. This is a source of no concern, since it is due simply to the desired chemical irritation of the chromic surgical gut.

SUMMARY

1. An explanation for recurrence of pterygiums is offered.

2. A new modification of the McReynolds transplantation for pterygium is presented. Use of this new procedure reduces the number of recurrences to a minimum.

3. A traction suture for broad and large pterygiums is described.

30 East Sixtieth Street, New York.

ARACHNOIDITIS

DANIEL KRAVITZ, M.D.
BROOKLYN

ARACHNOIDITIS is a comparatively new entity in the field of neuro-ophthalmology. It is an inflammation of the leptomeninges, which may be localized or diffuse, even to the extent of involving the entire central nervous system.

HISTORICAL REVIEW

The pathology of the serous form of meningitis was first described by Quincke in 1893, and in 1898 Schlesinger [1] described the localized cystic form. It was Horrax,[2] working at Cushing's clinic, who gave this condition a new clinical interpretation when he presented 33 cases of pseudocerebellar tumors which on operation proved to be cases of arachnoiditis.

In 1929 Cushing and Eisenhardt [3] were the first to recognize the chiasmic form when, in one of the classic monographs on chiasmal tumors emanating from Cushing's clinic, they mentioned chronic cisternal arachnoiditis as a condition to be differentiated from tumors of the chiasm. However, the importance of this contribution was overlooked in the larger and more important aspects of the paper. In the same year Holmes [4] presented 2 cases of arachnoidits in which he successfully operated for failing vision, but it was Balado and Satanowsky [5] who reported the first case of chiasmic arachnoiditis on record in which operation was successfully performed.

ETIOLOGY

Cushing [6] early recognized that infections could play an important part in causing arachnoiditis in the chiasmal region, and he stated that

Read before the Brooklyn Ophthalmological Society, Dec. 20, 1945.

1. Schlesinger, A.: Beiträge zur Klinik der Rückenmarks und Wirbeltumoren, Jena, Gustav Fischer, 1898.

2. Horrax, G.: Generalized Cisternal Arachnoiditis Simulating Cerebellar Tumor, Arch. Surg. **9**:95 (July) 1924.

3. Cushing, H., and Eisenhardt, L.: Meningiomas Arising from the Tuberculum Sellae, Arch. Ophth. **1**:1 (Jan.); 168 (Feb.) 1929.

4. Holmes, G.: Suprasellar Tumors, Internat. Cong. Ophth. (1929) **3**:65, 1930.

5. Balado, M., and Satanowsky, P.: Tratamiento quirurgico de la atrofía de la papila, Arch. argent. de neurol. **4**:71 (March) 1929.

6. Cushing, H.: The Chiasmal Syndrome, Arch. Ophth. **3**:305 (May); 704 (June) 1930.

diseases of the paranasal sinuses, because of their location, were an important etiologic factor. Bollack, David and Puech [7] were able to trace the probable cause in only 81 out of 129 case of arachnoiditis reported by them. There was an antecedent history of trauma in 15 per cent, and in the remainder an infection or a toxic condition was the causative agent. Diseases of the sinuses, nose and tonsils led, with 13 per cent; syphilis was second, with 9 per cent, followed by otitis, with 5 per cent and tuberculosis, with 4 per cent; and the rest of the cases were scattered among many other morbid conditions, such as rheumatic fever, influenza, dental infections, pregnancy and alcoholism. A study of the literature shows a general agreement with these figures.

Trauma, especially to the head, seems to play a definite, though at times a doubtful, part, for, as Bollack, David and Puech pointed out, there does not seem to be any definite relation between the location, the intensity of the trauma or the time interval and the subsequent development of the arachnoiditis. Thus, Goldsmith [8] reported 3 cases of traumatic origin. In 1 case there was a history of injury followed by unconsciousness eleven years before the onset of symptoms. In the second case the symptoms came on immediately after the patient regained consciousness from a head injury, and in the third the symptoms appeared four months after a fall which slightly dazed the patient. In other cases reported the condition had apparently followed injuries even more trivial than the latter, and in evaluating the history of trauma one must bear in mind that the vast majority of people at some time or other have had trauma to the head.

Hausman,[9] more than any one else, brought out the importance of syphilis as a cause of arachnoiditis. In several papers, he pointed out the fact that syphilitic arachnoiditis is no different from arachnoiditis from any other cause. Bollack, David and Puech also found that the majority of the cerebromeningeal forms of arachnoiditis were syphilitic in origin.

As previously mentioned, infections of the nasal and paranasal sinuses are the most frequent cause of arachnoiditis, but unusual sources of infection should not be overlooked. In 1 of my cases the condition apparently followed severe chilling from exposure to the rain. Bailliart, David and Schiff-Wertheimer [10] reported the case of a man

7. Bollack, J.; David, M., and Puech, P.: Les arachnoïdites opto-chiasmatiques, Paris, Masson & Cie, 1937.

8. Goldsmith, A. J. B.: Chiasmal Arachnoiditis, Proc. Roy. Soc. Med. **36**:163 (Feb.) 1943.

9. Hausman, L.: Syphilitic Arachnoiditis of the Optic Chiasm, Arch. Neurol. & Psychiat. **37**:929 (April) 1937.

10. Bailliart, P.; David, and Schiff-Wertheimer: Arachnoïdite opto-chiasmatique avec cécité totale, Bull. Soc. d'opht. de Paris, June 1934, p. 293.

who had rapid loss of vision and palsy of the third nerve on the left side following removal of a left lower molar tooth. Operation revealed arachnoiditis localized to the chiasmic region.

PATHOLOGY AND MORBID ANATOMY

Normally, there is a space between the pia and the arachnoid, the subarachnoid space, and between the two layers there are numerous fine fibrous strands, called the arachnoidal trabeculae. Sometimes the subarachnoid space is so narrow that the two layers appear as one, an inner vascular portion (pia) and an outer, thicker vascular layer (arachnoid).

Arachnoiditis, or inflammation of these membranes, is either adhesive or cystic in form. The cysts are collections of cerebrospinal fluid walled off by adhesions, and the fluid may at times be under great tension. The adhesive form is characterized by dense adhesions, which may bind the optic nerves and chiasm to any or all of the surrounding structures and in the advanced stage calcareous plaques and small cysts are usually present. The inflammation may involve either the pia or the arachnoid alone, but in the vast majority the two layers are simultaneously affected. Usually, the subarachnoid space is entirely obliterated, but in the areas where the inflammation is less severe some traces of the space may be found, while in cases of very severe inflammation even the subdural space is obliterated and the arachnoid becomes acellular and is composed of dense collagenous tissue.

The optic nerves and chiasm are usually involved in the opticochiasmic type of the disease. The appearance of the nerves is somewhat unusual in that in most cases there seems to be a combination of primary and secondary atrophy. This peculiar combination is a result of increased intracranial pressure, and at the same time adhesions are constricting the chiasm or the nerves or both. In addition, as Spaeth [11] has shown, there may be marked distortion of the blood vessels in that region, with interference of the blood supply to the delicate nerve structures.

SYMPTOMS

The symptoms to a considerable extent depend on the location, extent and severity of the lesions. Headache is frequent with arachnoiditis; it may be present in any part of the head and is usually severe. To the ophthalmologist the visual symptoms are of paramount importance. In the opticochiasmatic form of arachnoiditis sight is frequently jeopardized and the disks are rarely normal. There may be primary, secondary or a segmental type of atrophy of the optic nerve,

11. Spaeth, E. R.: Swelling of the Nerve Heads with Arachnoiditis and Unusual Changes in the Visual Fields, Arch. Ophth. **12**:167 (Aug.) 1934.

or even extreme degrees of choked disk, or any combination or gradation of these signs.

A central scotoma is common, being present in 31 per cent of the cases reported by Bollack, David and Puech, a finding corroborated by most authors. Cushing stated that the presence of a large central scotoma in cases of suspected chiasmal lesions is in favor of a diagnosis other than tumor.

Occasionally one sees typical bitemporal field defects, but more often they are bizarre because of extensive involvement of the nerves, chiasm and surrounding blood vessels by adhesions. In Spaeth's case there were binasal field defects, and on operation the large blood vessels were observed to be bound down to the sella turcica. Similar field defects have been reported by others. Unusual altitudinal field defects have been observed by a number of authors.

However, the most outstanding symptom in this form of arachnoiditis is the early, and usually rapid, loss of vision, sometimes involving one eye before the other. This loss is often so rapid and so extensive that one must agree with Hartmann [12] that in some cases the loss of vision is due not only to pressure on the optic nerves and chiasm but to actual involvement of these structures in the inflammatory process. In some cases impairment of the blood supply may be an important factor in the loss of vision.

With the visual changes, there may be all the symptoms characteristic of chromophobic adenoma of the anterior lobe of the pituitary gland or of a suprasellar cyst: polydipsia, polyuria, hyperthermia, obesity of the Fröhlich type (sex infantilism) and dyspituitarism. Barcala [13] reported the case of a youth aged 15 who presented a typical Fröhlich syndrome, but with edema of the disks, central scotomas and normal peripheral fields.

If the arachnoiditis is more anterior, symptoms referable to tumor of the frontal lobe may be simulated, i.e., anosmia and a more or less typical Foster Kennedy syndrome. Baillart and Schiff-Wertheimer's case presented a typical Foster Kennedy syndrome, and Vail [14] was able to collect several similar cases from the literature.

The symptoms in other forms of arachnoiditis vary greatly. Ocular motor paralyses are frequent. Occasionally choked disks may be the only ocular finding, or the fundi may be entirely normal. At times arachnoiditis may simulate cerebral tumor so closely that the true path-

12. Hartmann, E.: Optochiasmic Arachnoiditis, Arch. Ophth. **33**:68 (Jan.) 1945.

13. Barcala, F. J.: Sindrome de Froehlich seudotumoral con arachnoiditis quiasmatica, Semana méd. **2**:498 (Aug. 26) 1943.

14. Vail, D.: Optochiasmic Arachnoiditis, Arch. Ophth. **20**:384 (Sept.) 1938. Heurer, G. J., and Vail, D. T., Jr.: Chronic Cisternal Arachnoiditis Producing Symptoms of Involvement of Optic Nerves and Chiasm, ibid. **5**:334 (March) 1931.

ologic process is not revealed until operation is performed. This is particularly true, as Demel [15] has shown, of the localized types of arachnoiditis, with which there may be choked disks, vomiting and epileptiform attacks, or the convulsions may be jacksonian in type.

PROGNOSIS

The prognosis on the whole is good, especially as regards vision, if operation is resorted to early. Of course, if the condition has lasted too long, the loss of vision becomes irrevocable. As previously pointed out, in some cases the loss of vision is due to actual inflammation of the nerves and chiasm. In such cases the prognosis is poor, and, as the presence of such a process cannot be predicted, the preoperative prognosis should be guarded.

DIAGNOSIS

Because of its polymorphous manifestations, the diagnosis of arachnoiditis is not easy. The chiasmic type gives symptoms referable to pressure in that region. However, unlike the changes of true tumors of the pituitary gland, the sella turcica is usually normal on roentgenographic examination, and typical bitemporal field defects are rare. The rapidity of development of the visual symptoms favors the diagnosis of arachnoiditis rather than tumor. In addition, the disks, instead of primary atrophy show a peculiar mixture of primary and secondary atrophy, often with moderate edema. This feature was strongly stressed by di Marzio, Cavina and di Nigris,[16] Bollack, David and Puech,[7] Vail,[14] Lillie,[17] Hartmann [12] and others.

From the demyelinating diseases, such as multiple sclerosis, arachnoiditis is differentiated by absence of a history of remissions and by the neurologic signs and from Devic's and Schilder's disease (optic neuroencephalomyelopathy and progressive subcortical encephalopathy) by their typical course after the initial onset. In Leber's optic atrophy there is a hereditary factor, and blindness is never complete. In the toxic amblyopias there is early loss of central vision and the fundi usually remain normal for a long time. Optic neuritis from sinus infection is more difficult to exclude, for this condition is a cause of arachnoiditis. If infection is present, the sinuses should be cleaned out before further exploration is undertaken. Encephalographic and ven-

15. Demel, R.: Die Meningitis serosa circumscripta cerebralis unter dem Bilde des Hirntumors und ein Beitrag zur ihrer Aetiologie, Arch. f. klin. Chir. **125**:561 (Sept.) 1923.

16. di Marzio, Q.; Cavina, C., and di Nigris, G.: Sulla aracnoidite optochiasmatica, Riv. oto-neuro-oftal. **13**:291 (July-Aug.) 1936.

17. Lillie, W. I.: Prechiasmal Syndrome Produced by Chronic Local Arachnoiditis, Arch. Ophth. **24**:940 (Nov.) 1940.

triculographic studies are important because they may show abnormality of the cisternal and ventricular systems.

TREATMENT

Rubino [18] claimed that in 3 cases vision improved with intravenous injections of iodides. However, he and all other authors unanimously agreed that the treatment for this condition is primarily surgical. This becomes imperative if great loss of vision is threatened, and it is important to remember, as Hausman has shown, that the same treatment is essential in the arachnoiditis due to syphilis. David, Hartmann and Hébert [19] also stressed this point, and they further stated that even in tabes the loss of vision may be due to arachnoiditis. They reported a case of tabes in which loss of vision in the lower fields developed. At operation arachnoiditis was found; and when the adhesions around the nerves were separated there was some recovery of vision. However, it is difficult to decide when to operate in these cases. On the whole, as the aforementioned authors pointed out, if conservative treatment fails, operative treatment is advisable because of the threat to vision. Surgical separation of the arachnoidal adhesions has effected a cure in cases of epilepsy and convulsions which were due to focal irritations of the cortex. One must also remember that long-standing choked disks result in secondary atrophy and blindness and that, in the absence of localizing signs, trephination to relieve intracranial pressure may ward off threatened blindness.

REPORT OF CASES

CASE 1.—M. G., a man aged 24, was admitted to the New York Post-Graduate Hospital on Aug. 18, 1939, with a history of major and minor convulsive attacks since early childhood. He also complained of blurred vision and was partially deaf. The convulsive attacks had their onset in early childhood following a fever for a short period, during which he had two convulsions.

Neurologic examination revealed nothing significant except that the convulsions seemed to be initiated in the left cortex. The vision, visual fields and fundi were normal.

The encephalogram, taken on August 21, was reported to show that the bones of the vault were rather thick and dense with moderate hyperostosis on the inner table in both frontal regions. The sella turcica was smaller than normal. The ventricular system was enlarged but symmetric, and there was definite evidence of cortical retraction.

The patient was discharged because no definite diagnosis was made; but, as he continued to have numerous minor and a few major convulsive seizures,

18. Rubino, A.: Contributo allo studio dell aracnoidite ottico-chiasmatica, Riv. oto-neuro-oftal. **14**:552 (Nov.-Dec.) 1937.

19. David, M.; Hartmann, E., and Hébert, E.: Arachnoïdite et compression vasculaire du chiasma chez un tabétique, Bull. Soc. d'opht. de Paris, December 1936, p. 789.

he was readmitted on Nov. 23, 1939, for further study. Again, the neurologic and ophthalmic examinations showed nothing abnormal, and a second encephalogram showed no change from the preceding one. The patient was discharged without a diagnosis.

He was readmitted on March 27, 1940 because the convulsions had increased in frequency. It was decided to open the cranium over the left frontal area and search for a localized focus of irritation. This was done by Dr. J. A. MacLean on March 28. Extensive arachnoidal adhesions were observed and were freed with great difficulty.

When he was last seen at the clinic, on March 5, 1942, he stated that he had had no attacks since the operation.

This is an interesting case of chronic adhesive arachnoiditis in which, in spite of extensive involvement of the anterior part of the brain, no part of the visual pathways was involved and no neurologic signs were present except for a focal irritation of the brain.

CASE 2.—M. W., a woman aged 29, came to the Post-Graduate Hospital on March 3, 1929, because of menstrual disturbances for the past six years and failing vision for the past four years.

Previous to the onset of symptoms her menses came regularly every twenty-eight days and lasted four days. Now they came every two weeks and lasted one day. The visual disturbances began with blurring in one eye and then in the other, and vision had deteriorated steadily since the onset.

Neurologic examination revealed nothing abnormal, but ophthalmic examination showed pallor of both disks and left homonymous hemianopsia.. Operation was performed for tumor of the pituitary gland but none was found, and the patient was discharged after recovery from the operation.

Unfortunately, all the original records were lost, so that more detailed information is not available.

She was readmitted on Oct. 14, 1930, with the history that after operation vision had failed more rapidly and she had gained considerably in weight, about 63 pounds (28.6 Kg.). She had not had her menses since the operation. For the past five months she had had polyuria and polydipsia.

An encephalogram revealed a normal ventricular system and normal sella turcica, and she was again discharged for further care in the outpatient department. She was placed under mixed glandular therapy, and at intervals roentgenograms of the skull were taken. These always revealed no pathologic change.

The patient was readmitted to the hospital on Aug. 11, 1933 because her symptoms had become worse. Examination of the eyes showed a mixed type of primary and secondary atrophy of the optic nerve. The right eye was blind, and only an island of vision was retained in the temporal field of the left eye. A ventriculogram, taken on August 21, revealed dilatation of the left ventricle with cortical atrophy. The right ventricle was normal.

Operation on August 31, by Dr. John Scarf, revealed extensive chiasmic arachnoiditis, with a large cyst which had lifted the chiasm upward. The cyst was emptied and the adhesions were ruptured, but the patient's condition was not improved. When she was last seen, on April 2, 1942, there were progressively increasing drowsiness and great impairment of memory.

The first operation was performed before the entity of chronic arachnoiditis was well known. If the adhesions had been separated then,

the subsequent course of the patient's condition might well have been different.

CASE 3.—F. D., a girl aged 17 years, came to the Brooklyn Hospital on May 4, 1937, because of transitory attacks of blurred vision and progressive loss of sight for the past four months.

About ten months before admission, the patient awoke one night and vomited three or four times. She was very dizzy and had pain over the left eye. The next morning she was well. Five months later, she had tinnitus in the right ear, which lasted over an hour. She described her attacks of blurred vision as a feeling that she was looking through a fog. The visual disturbances had been occurring with increasing frequency. Three weeks before admittance she had an attack of blurred vision which was accompanied with such dizziness that she fell. Her menstrual periods started at the age of fourteen years and had occurred regularly every twenty-eight days until three months before her admission, when they became scanty and occurred every two weeks.

Examination.—The patient had a large amount of pubic hair and a moderate streak of hair extending up to the umbilicus. Her arms, legs and thighs were also hairy. There were slight diminution of sensation over the right side of the face and a suggestion of weakness of the right side of the face during the emotional phase.

Ophthalmic Examination.—Vision was 13/200 in the right eye and was limited to counting fingers at 6 inches (15 cm.). There were no ocular palsies and no nystagmus. The right pupil reacted well to light and the left sluggishly; both reacted in accommodation. The right disk was swollen about 3 D., and there was pronounced secondary atrophy of the disk. The left disk was less edematous but showed a greater amount of atrophy. The right field was markedly and irregularly contracted for a 20 mm. test object. There was an island remaining in the left field with a 40 mm. test object.

Flat roentgenograms, taken on May 5, showed that the bones of the skull had a wavy unevenness in density. The suture lines, especially the occipital, were separated. A ventriculogram taken on May 12 showed that the lateral and third ventricles were greatly distended but normal in position. The cerebral aqueduct and the fourth ventricle were not visualized.

The impression was that of obstruction below the third ventricle.

A preoperative diagnosis of chronic arachnoiditis was made, and a posterior craniotomy was done by Dr. E. J. Browder the same day. Extensive adhesive arachnoiditis was observed. The adhesions could not be separated, so the area was left decompressed.

After recovery, the patient was discharged to the outpatient department, where she was under observation about three years. From time to time the decompressed area bulged considerably because of episodes of increased intracranial pressure, but her headaches and vomiting disappeared and with time her vision and visual fields improved. At the last examination, on Feb. 28, 1940, vision was 20/100 in the right eye and 5/200 in the left eye, and the right visual field had improved considerably, although the optic disk appeared to be more atrophic. Since operation she had had no headaches, dizziness or vomiting.

CASE 4.—A. M., a woman aged 24, came to the Post-Graduate Hospital on Aug. 16, 1937, because of headaches, blurring of vision and nausea of four months' duration.

The symptoms started shortly after a third operation on the right mastoid with an attack of blurred vision, which lasted about fifteen minutes and was followed by a period of freedom from symptoms for about two weeks. Then the attacks of blurred vision became more frequent and severer. Most of the attacks were followed by right-sided headaches, which lasted three or four days and were accompanied with nausea and vomiting. The patient also stated that at times she saw double.

Except for impaired smell in the right nostril and impaired hearing on the right side, the neurologic examination revealed nothing abnormal. The patient had normal vision and visual fields, and the fundi appeared normal.

An encephalogram, taken on August 18, showed a normal state except that the sella turcica was 20 per cent undersized.

The patient was discharged without a diagnosis and was readmitted on September 24 because, in addition to the aforementioned symptoms, severe tinnitus had developed on the right side. A block of the right stellate ganglion was done by Dr. J. A. MacLean, with relief of symptoms for several months.

On June 7, 1938, the optic disks began to appear engorged, and spinal tap verified the presence of increased intracranial pressure. A craniotomy in the region of the right mastoid revealed a large arachnoid cyst. This was evacuated and the adhesions were ruptured. The patient has remained well since.

CASE 5.—H. T., a man aged 28, was admitted to the Post-Graduate Hospital on Oct. 11, 1939, with a history of convulsions for the past two years. The convulsions started with a cramp in the left leg and spread upward to the arm. The face was never involved. The convulsions were followed by loss of consciousness, which lasted three or four minutes. There was no biting of the tongue or frothing at the mouth. He gave no history of trauma.

A neurologist had sent the patient to the hospital with a diagnosis of jacksonian epilepsy and had made a preoperative diagnosis of parasagittal meningioma.

An encephalogram, taken on October 13, showed slight flattening of the lateral ventricles. Ophthalmic examinations revealed only a slight contraction of the fields.

A craniotomy over the right parietal area, by Dr. J. A. MacLean, revealed localized chronic adhesive arachnoiditis, which was secondary to an old subarachnoid hemorrhage (traumatic). The scar tissue was excised from the involved area. Since the operation the patient has had only occasional convulsive attacks.

CASE 6.—S. L., a man aged 40, was admitted to the Post-Graduate Hospital on Dec. 15, 1934, with a history of diplopia for the past two years and headaches for the past two weeks. With these headaches there were frequent attacks of nonprojectile vomiting. In addition, for the past ten months he had yawned frequently, and for the past few months he had had frequent attacks of hiccup. For a long time there were mild occipital and frontal headaches, but for the past two weeks these headaches had become extremely severe, especially on moving the head. About two years before, shortly before the symptoms started, he was injured while riding in a taxicab. He was not unconscious but had severe headaches for a few days.

Examination.—The patient was drowsy but responded to questions. The right upper lid was ptosed, and the left lateral rectus muscle was paretic. There was a marked lateral nystagmus to the left, with the rapid component to the medial side. The nystagmus to the right was slight. The pupils were equal and regular and reacted to light and in accommodation. The right disk was slightly blurred,

and the left was normal. The visual fields and visual acuity could not be determined. Neurologic examination revealed nothing abnormal except for a slight increase in the reflexes on the right side. Flat roentgenograms of the head showed a normal condition.

On Jan. 14, 1935, the disks, especially the right, showed increased edema. In a ventriculogram, taken on January 23, the third ventricle was not visualized, and a diagnosis of tumor of the third ventricle was made. A suboccipital craniotomy, done on the same day by Dr. J. A. MacLean, revealed extensive chronic adhesive arachnoiditis. The patient did not respond after operation and died a few days later. Permission for autopsy was not obtained.

CASE 7.—M. Di B., a girl aged 7 years, was admitted to the Post-Graduate Hospital on Oct. 13, 1936, because of frequent vomiting and occasional headaches for the past three weeks.

About a week prior to the onset of symptoms the child had come from school in a cold drizzling rain and had received a thorough wetting. That night she had chills and for the next two weeks had a cold, without fever. A week before hospitalization she fell and struck her head, but not severely.

Examination.—The right pupil was larger than the left, and the corneal reflex was absent on the left side. The left lateral rectus muscle was completely paretic. The right disk was slightly blurred, and the left disk was normal. Neurologic examination revealed rigidity of the neck and deviation of the tongue to the left. There was weakness of the right side of the face, a Babinski sign on the right side and a questionable Babinski sign on the left.

On October 16, the right disk was swollen about 5 D. and the left disk about 1 D. A ventriculogram, made that day, showed blocking in the cerebellar area.

A suboccipital craniotomy, performed by Dr. John Scarf the next day, revealed extensive cystic arachnoiditis in the region of the fourth ventricle. The cyst exerted great pressure on the cerebellum, and the foramens of Magendie and Luschka were closed by adhesions. The cyst was evacuated and the adhesions were separated. The child did not respond after the operation and died two days later. Permission for autopsy was not obtained.

CASE 8.—M. G., a woman aged 22, came to the Post-Graduate Hospital on March 2, 1937, with a history of nausea, vomiting and headaches for the past two years. The symptoms followed shortly after operation for acute appendicitis. The headaches were severe and were localized to the left side of the head. The vomiting was not projectile.

Ophthalmic and neurologic examinations revealed a normal state, and a ventriculogram, made on March 4, showed no evidence of a lesion encroaching on the ventricular system. Dr. J. A. MacLean, therefore, injected the stellate ganglion, thus giving symptomatic relief to the patient, and she was discharged from the hospital. The patient returned to the outpatient department, where the ganglion was blocked several times, always giving her symptomatic relief.

On September 24, with the patient under anesthesia induced with solution of tribromoethanol U.S.P. and oxygen, a preganglionic section of the superior cervical sympathetic ganglion was done and the presence of chronic adhesive arachnoiditis was noted. No further surgical measure has been attempted because the patient has been free of headaches to date.

CASE 9.—A. J. M., a man aged 44, came to my office on Nov. 19, 1935 with a history of headaches for over twenty years. About five years before his admission the headaches became very severe and he vomited several times. He was

told that he had sinusitis and he underwent treatment. For the few months preceding admission, he had had severe dizzy spells several times daily, and he fell on two occasions. Lately, print seemed to "fly" and appeared blurred.

Examination.—Vision was 5/200, improved to 20/25, in the right eye, and 5/200, improved to 20/50, in the left eye. The right disk showed choking of about 5 D., with a few hemorrhages around it, and the left was swollen about 2 D. The blindspots were enlarged, but the peripheral fields were full and showed no localizing defects.

A tentative diagnosis of tumor of the frontal lobe was made, and the patient was referred for neurologic examination. This showed nothing significant.

The patient's vision deteriorated rapidly. A thorough examination, including ventriculograms, at the Johns Hopkins Hospital, revealed no localizing lesion. On November 26 Dr. Walter Dandy made a trephine opening over the right parietal area and probed for a tumor but found none. A diagnosis of arachnoiditis was made, and the trephine opening in the bone was left open. Dr. Dandy felt that if the intracranial pressure had not been relieved secondary atrophy of the nerve and blindness would have resulted.

The patient has been under constant observation since and was last examined on June 11, 1945. Vision has remained at 20/20 with correction in both eyes; the peripheral fields are full, but the blindspots are still enlarged. At times the area of trephination is soft; at other times it is rather hard, so that the brain herniates through the wound and feels tense. At such times one can feel, and even see, pulsations of the herniated part of the brain, and the patient usually has headache and feels nauseated. These symptoms are accentuated by even the slightest pressure over the herniated area. The disks during these episodes become engorged, but this feature is not constant. The borders of the disks are not well outlined, but there is no evidence of secondary atrophy. According to the patient, the intracranial pressure seems to be affected greatly by changes in the weather.

CONCLUSION

Arachnoiditis is not so rare an entity as is commonly thought. At the New York Post-Graduate Medical School and Hospital between 1935 and 1940, inclusive, there were 118 cases of suspected neoplasm; in 67 of these cases the condition was definitely diagnosed as neoplasm, and in 11, arachnoiditis, that is in 14 per cent of the total number of cases in which a diagnosis was made.

Judging from the number of papers in the literature, there has been an increasing awareness of this condition among ophthalmologists. However, the criteria for its diagnosis are still difficult, and in too many cases the necessary surgical treatment is not carried out. The greatest difficulty lies in the differentiation of cases of arachnoiditis from the unfortunately large number of cases in which the optic nerves are directly involved and the process is not arachnoiditis. It is small comfort to a patient to undergo a formidable operation on the head because of a mistaken diagnosis. Fortunately, neurosurgery has advanced to such a degree that the operative and postoperative mortality rates are very small. Every ophthalmologist has permitted loss of vision to progress to complete blindness as he stood helplessly by, because

the roentgenograms of the sinuses did not reveal any disease process and no localizing signs were present. Early surgical intervention in some of the cases might have saved vision.

It must also be emphasized that, though opticochiasmic arachnoiditis presents a great threat to vision, other forms of arachnoiditis can be as great a threat, as cases 3 and 9 show. One can speculate as to what would have happened if the patient in case 3 had come for treatment at an earlier time.

Because ophthalmologists are usually consulted by the neurosurgeon in all cases of suspected tumor of the brain, they must be aware of the fact that localized arachnoiditis can simulate a tumor of any part of the brain. These lesions are less likely to cause field defects because the cortex is irritated by scars from the membranes covering the brain and are therefore superficial.

With the increasing attention given this subject, it is hoped that with time arachnoiditis will be more easily diagnosed. Vision is so important a function that if a case presents the possibility of arachnoiditis surgical measures should not be postponed until too late.

861 Park Place.

EXOPHTHALMOS AND ASSOCIATED OCULAR DISTURBANCES IN HYPERTHYROIDISM

ISADORE GIVNER, M.D.

MAURICE BRUGER, M.D.
AND
OTTO LOWENSTEIN, M.D.
NEW YORK

WHEN Marine and his associates [1] produced chronic progressive bilateral exophthalmos by daily intramuscular injections of 0.05 to 0.1 cc. of methyl cyanide in 2 to 3 month old rabbits maintained on a diet of alfalfa, hay and oats, he came to the following conclusion:

> Cyanides appear to act by inhibiting metabolic processes. This inhibition stimulates the hypothalamic centers which in turn, stimulate the pituitary to produce the thyrotropic hormone, which in turn stimulates the thyroid gland and independently the sympathetic centers in the mid-brain, causing exophthalmos.

It occurred to us that since pupillography, as devised by Lowenstein and associates,[2] can show evidences of central sympathetic disturbances, it might be advantageous to determine what these changes are which occur with hyperthyroidism. Accordingly, 22 patients were studied; these included patients with and without exophthalmos and patients with unilateral exophthalmos. The results were interesting (fig. 1). All but 1 patient showed a redilation block, interpreted by Lowenstein as evidence of central sympathetic disturbance. No explanation can be given at present as to why this patient did not show this pattern. However, the appearance in practically all cases suggested further value for this test. Occasionally in cases of unilateral exophthalmos the general evidences of hyperthyroidism may not be apparent or may be borderline. It seemed that a positive pupillographic

From the Department of Ophthalmology and the Thyroid Clinic (Departments of Medicine and Surgery) of the New York Post-Graduate Medical School and Hospital.

1. Marine, D., and Rosen, S. H.: Exophthalmos in Thyroidectomized Guinea Pigs by Thyrotropic Substance of Anterior Pituitary, and Mechanism Involved, Proc. Soc. Exper. Biol. & Med. **30**:901 (April) 1933.

2. Lowenstein, O., and Friedman, E. D.: Pupillographic Studies, Arch. Ophth. **27**:969 (May) 1942; Adie's Syndrome (Pupillotonic Pseudotabes), ibid. **28**:1042 (Dec.) 1942. Lowenstein, O., and Givner, I.: Pupillary Reflex to Darkness, ibid. **30**:603 (Nov.) 1943. Lowenstein, O., and Levine, A. S.: Pupillographic Studies, ibid. **31**:74 (Jan.) 1944; The Role of the Sympathetic in the Light of Pharmaco-Pupillographic Studies, Proc. Rudolf Virchow M. Soc., 1943, vol 2, p. 82.

curve might add to the information at hand. Accordingly, pupillographic studies were made on 5 patients without hyperthyroidism who had unilateral exophthalmos due to various causes, such as meningioma of

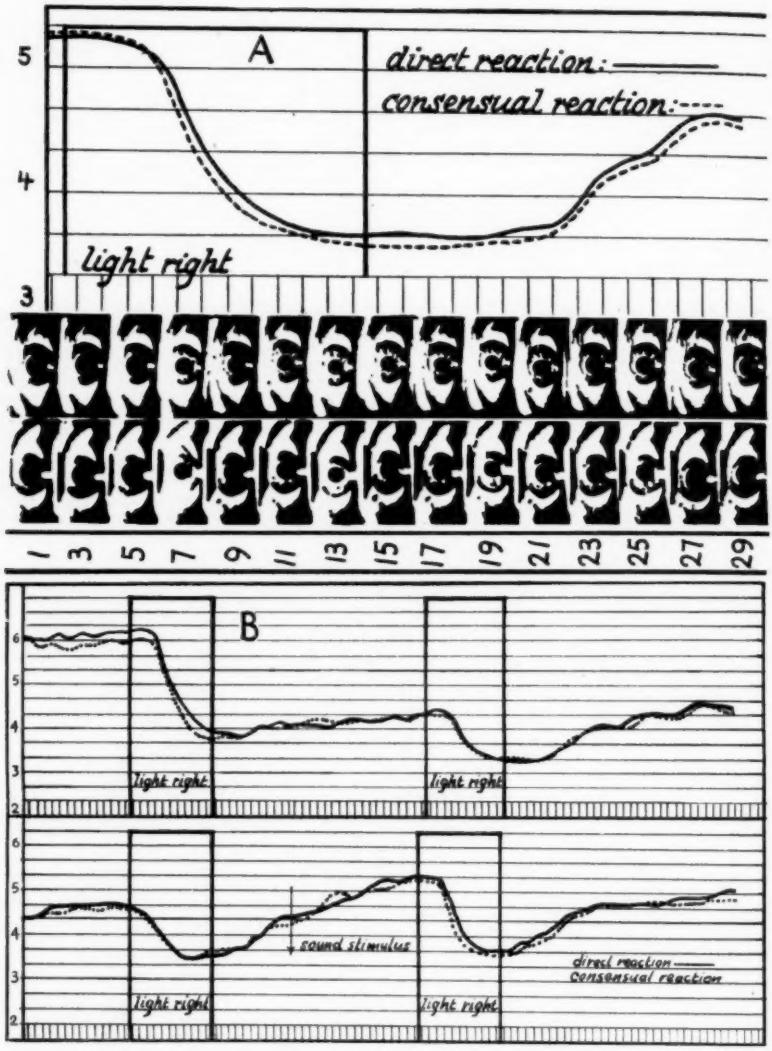


Fig. 1.—*A*, normal pupillographic curve, showing a period of latency, a contraction, a period of latency and a redilation. *B*, pupillographic curve in a case of hyperthyroidism, showing a period of latency, and a contraction, a period of latency and a redilation block.

the sphenoidal ridge and hemangioma of the orbit. The unilateral exophthalmos of 1 patient was unexplained. For all patients studied normal curves were found. The additional case of a nurse (R. W.)

in whom unilateral exophthalmos had developed is worthy of note. A pupillographic study showed a typical redilation block, suggesting that this case probably was one of hyperthyroidism.

REPORT OF CASES

CASE 1.—R. W., a nurse, single, aged 31, first noticed exophthalmos of the right eye in July 1943. The basal metabolic rate was 4 per cent above the average normal. A roentgenogram of the sphenoidal ridge, the orbit and the thymus revealed nothing abnormal. On Dec. 9, 1943, the right palpebral aperture was 11 mm. and the left 9 mm. With the Hertel exophthalmometer at 100 mm., exophthalmos measured 20 mm. in the right eye and 19 mm. in the left eye. There were a fine tremor of the fingers and sweating of the hands. Pupillographic study showed an incomplete dilation block on both sides. Anisocoria of sympathetic origin existed. The conclusion was that since the pupillographic study revealed a bilateral condition the lesion was probably present in the hypothalamic region. On Jan. 4, 1945, with the base line at 100 mm., the right eye measured 19 mm. and the left eye 18 mm. The value of pupillography in the diagnosis of unilateral exophthalmos can only be established after many more similar cases are studied and followed through their course of development.

The evidence accumulated by Mulvaney [3] supports his contention that the immediate cause of exophthalmos, whether it be of the thyrotoxic or of the thyrotropic type, resides in the extraocular and smooth muscles of the eyeball, Tenon's capsule and the lid. In the case of thyrotoxic exophthalmos, it is essential to know whether, in addition to removal of the sympatheticonia and lowering of the thyroxin content of the blood, the flabbiness of the muscles, with loss of striation, granular changes in the sarcoplasm and alterations in the neurolemmal sheaths, can be reversed. In the case of thyrotropic exophthalmos, can the round cell infiltration and fibrosis be lessened? Since neostigmine has been of value in treatment of myasthenia gravis and atony of the bladder and intestinal wall, 5 patients with hyperthyroidism were given 15 mg. of neostigmine bromide orally three times daily for three to four months. The drug was administered postoperatively, when all factors but the essential changes in the muscles themselves had apparently been brought nearer to normal. No measurable reduction of the exophthalmos was noted. Since vitamin E had been suggested in the treatment of the muscular dystrophies, this vitamin, in the form of the acetate ester of alpha tocopherol (Ephynal acetate), was administered orally in doses of 25 mg. three times daily for six weeks to 5 patients with hyperthyroidism. Here, again, the medication proved of no value. Similar negative results were obtained following the oral administration of 25 mg. of pyridoxine hydrochloride three times daily for six weeks to 5 patients with hyperthyroidism.

3. Mulvaney, J. H.: Exophthalmos of Hyperthyroidism, Am. J. Ophth. 27:589 (June) 1944.

On the introduction of thiouracil, it was hoped that with the reduction of the basal metabolism in patients seen early enough the exophthalmos would also recede. Results to date have proved otherwise. Even in cases in which most features of hyperthyroidism were abolished the exophthalmos either remained the same or increased. With thiouracil, changes in the pituitary gland have been noted which simulate those following thyroidectomy. Under the influence of this drug, the iodine content of the thyroid gland is rapidly depleted. The drug interferes with the synthesis of thyroxin in the thyroid gland; the glandular hyperplasia is a response to the lack of thyroid hormone, and this cannot take place in the absence of the hypophysis or, presumably, without the intermediation of the thyrotropic hormone of the anterior lobe of the pituitary.

To offset the pessimistic view that exophthalmos once established will not recede, it should be noted that exophthalmos has been reversed in some cases following the administration of iodine and during pregnancy. As proved by measurements with the exophthalmometer, the administration of iodine orally for several months reduced the exophthalmos in 3 patients.

The case in which exophthalmos was influenced by pregnancy is now reported.

CASE 2.—I. F., a white woman aged 34, noted an increase in her exophthalmos following thyroidectomy for hyperthyroidism, the degree of which finally became stabilized. She subsequently became pregnant. At the beginning of the second trimester the exophthalmos began to show improvement and continued to do so up to the time of delivery. Exophthalmometer readings showed that the exophthalmos had receded 4 mm., demonstrating that the changes in the extraocular muscles were reversible. Interestingly, the baby was born with exophthalmos, which did not recede fully until the age of 1 year.

Dr. S. S. Ellenson [4] gave the following report of a case.

L. F., born of a mother with active hyperthyroidism, had a weight at birth of 5 pounds 3 ounces (2,353 Gm.) and was premature in appearance. The infant had severe bilateral exophthalmos (fig. 2). The pulse rate was over 200 a minute. She was hyperactive. She had repeated attacks of respiratory difficulty, reaching deep cyanosis with attacks of apnea. The infant was discharged on the tenth day with the mother but was readmitted four days later because of continued spells of cyanosis. She was placed in an incubator, with intermittent administration of oxygen. Her weight was 4 pounds 12 ounces (2,154 Gm.). Twelve days later, having done well, weight 4 pounds 14 ounces (2,211 Gm.), she was again sent home. The urine was normal. On April 4, 1942, a blood count showed 126 per cent hemoglobin, 6,750,000 red cells, 13,800 white cells, 62 per cent polymorphonuclear leukocytes, 30 lymphocytes and 8 per cent mononuclear cells. On April 11, the hemoglobin concentration was still 126 per cent; the red cell count was 6,300,000 and the white cell count 10,000, with 19 per cent

4. Private communication to the authors.

polymorphonuclear leukocytes, 72 per cent lymphocytes and 9 per cent mononuclear cells. She made slow, steady progress at home, weighing 18 pounds 12 ounces (8,504 Gm.) at the age of 1 year. Some evidence of exophthalmos was still present. Centers of ossification in the wrist (two well formed bones) were normal for a child of her age. At 19 months of age she weighed 21 pounds 13 ounces (9,894 Gm.). At the age of 2 years 9 months (Jan. 14, 1944) her height was 36 inches (91 cm.) and her weight 29 pounds (13.2 Kg.). Fluoroscopic examination showed rapid bone development (four well formed bones in the wrist). There was no evidence of exophthalmos. The pulse was normal. The infant was normal in appearance and on physical examination. She has had the usual colds and sore throat (tonsillitis twice) and had responded normally to medication, including administration of ephedrine and sulfonamide drugs. The child is now 3 years old, and the mother's exophthalmos has stayed at a low level.

Fig. 2.—Baby L. F. at the age of a few weeks, showing the bilateral exophthalmos.

This raises the question as to what happened during pregnancy which favorably influenced the exophthalmos. Did the baby's thyroid or thymus act for the mother? Were there certain hormonal changes occurring either at the placental barrier or in the mother which produced changes in the muscles of the eyes? We are not in a position to answer these questions, but they suggest material for investigation.

The use of ergotamine tartrate in selected cases to narrow the palpebral aperture should be mentioned.

CASE 3.—S. T., a woman aged 29, six years ago began to take thyroid to stimulate loss of weight. She became nervous, lost weight and acquired a stare. A diagnosis of hyperthyroidism was made, and thyroidectomy was performed. Soon after the operation the exophthalmos began to progress slowly. Nine months after operation her father became acutely ill, and the patient attended him constantly. She then noted a rapid progression of the exophthalmos, the amount reaching 30 mm. in the right eye and 31 mm. in the left eye, with the exophthalmometer at 110 mm. She was given 1 mm. of ergotamine tartrate orally twice

a day; a temporary narrowing of the palpebral aperture was observed only while the drug was administered (fig. 3).

Tearing, which is occasionally a distressing symptom in thyroid dyscrasias, was treated by the administration of tincture of belladonna 15 minims (0.93 cc.) three times a day. The drug was valueless for relief of this symptom, and since it is possible that the dose is just sufficient to induce greater sympatheticonia (by abolishing the stabilizing vagotonia) the drug would seem to be contraindicated.

Chemosis, when observed, is due to venous obstruction. In an attempt to determine whether increased capillary permeability could be

Fig. 3 (case 3).—*A*, appearance of the palpebral aperture before the administration of 1 mg. of ergotamine tartrate; *B*, appearance forty minutes later.

demonstrated, Thiel's test was done (10 grains of fluorescein sodium every thirty minutes for three doses given by mouth). Observations with the slit lamp were made, but fluorescein failed to appear in either the anterior chamber or the chemotic conjunctiva.

Fig. 4.—Marked widening of the palpebral aperture, which produced increased intraocular pressure.

Attention should be called to an occasional rise in intraocular pressure dependent on the mechanical pressure of the upper lid on the globe. In 2 cases observed the exophthalmos was minimal, but the contraction of Müller's muscle in the upper lid was pronounced. Tonometric readings varied from 35 to 40 mm. of mercury (Schiøtz). There was no field defect or evidence of glaucoma. This condition needs no ocular treatment per se and is comparable in reverse to the

lowered intraocular pressure in the eye on the side of a unilateral peripheral facial paralysis as compared with the pressure in the sound eye (fig. 4).

The inhibiting action of thyroid secretion on the development of exophthalmos is further emphasized by the aggravation of the exophthalmos (thyrotropic type) after thyroidectomy, producing the so-called malignant type of exophthalmos and frequently necessitating the Naffziger operation in order to preserve vision. The value of the operation is well exemplified by case 4, in which the exophthalmos receded from 33 to 18 mm. The importance of uncapping the optic foramen is also stressed.

CASE 4.—M. J., a woman aged 34, underwent a subtotal thyroidectomy in March 1943. There is no record of exophthalmometric measurements previous to operation. Her basal metabolism before operation was 25 per cent above the average normal.

When she was first seen, on April 21, 1944, she stated that after the birth of a child two years and four months before she began to have "thyroid trouble." The exophthalmos began to increase two months after the operation.

Fig. 5 (case 4).—*A*, patient before a Naffziger operation was undertaken, showing the extreme left hypertropia, exophthalmos and venous congestion; *B*, appearance two months after operation.

On April 26, with the base line at 105 mm., her measurements were 32 mm. in each eye. Vision could be corrected to 20/30 in the right eye and to 20/100 in the left eye. Her near point of convergence was 45 mm. There was a scleral exposure of 5 mm. below the right cornea and of 4 mm. below the left cornea. Edema of the lids was graded as 3 plus and chemosis of the right conjunctiva as 1 plus. There was limitation of movement of the lateral rectus muscles, being greater in the right eye than in the left eye. Intraocular tension was 20 mm. in each eye. The fundus showed venous congestion of the retina. Thyroid substance was prescribed. Determinations of blood sugar and roentgenographic examination of the sella turcica were performed, the results of both being within normal limits. On July 14, the patient was taking 3 grains (195 mg.) of thyroid U. S. P. daily. Her basal metabolism on April 27 was 1 per cent above the average normal.

On July 21, she reported that for the past week she had been seeing double. Paresis of the right inferior rectus muscle was present. Examination of the visual fields at this time showed a central scotoma for red in both eyes and

loss of the superior temporal field for red in the left eye. Her fields were normal for a 3 mm. white test object at 330 mm. and vision was 20/25 in the right eye and 20/200— in the left eye. On July 28, vision had decreased to 20/70 in the right eye and to 20/200 in the left eye. Two roentgen treatments to the pituitary gland (40 r) were ordered, after which the patient became much worse, and on August 17, with a base line of 105 mm., her exophthalmos measured 33 mm. in each eye. Vision was reduced to 6/200 in each eye. The fields now showed bitemporal contraction with a 3 mm. white test object at 330 mm. and a central scotoma in each eye for both color and form. Examination on August 21 disclosed paresis of the depressors of the left eye, producing left hyperphoria. Vision, however, was 20/200 in the right eye and 3/200 in the left eye, and the chemosis had somewhat lessened.

A Naffziger operation was performed on August 28. The surgeon reported that there was little orbital fat and that the ocular muscles showed marked hypertrophy and appeared thick and gray. Five weeks later, with a base line of 105 mm., her measurements were 24 mm. in the right eye and 22 mm. in the left eye. Pulsations could be noted in the exophthalomometer. Vision in the right eye was now 20/25+ with correction, and she read Jaeger type 1. The central scotoma had disappeared. There was still weakness of the right inferior and lateral rectus muscles. Corneal sensitivity was reduced in this eye. In the left eye, the field was much worse and vision was limited to perception of hand movements. Optic nerve atrophy could now be seen in this eye. Roentgenograms of the optic foramens disclosed removal of the upper part of the right optic foramen but a closed ring in the left foramen, a condition which may account for the absence of visual recovery in the left eye. The patient was under treatment with 4 grains (0.26 Gm.) of thyroid given by mouth daily.

Her status at the time of this report shows that the exophthalmos has been further reduced to 18 mm., a total reduction of 15 mm. from the preoperative measurements. Vision is 20/30 in the right eye and is limited to perception of hand movements in the left eye (fig. 5).

An increase in the exophthalmos of hyperthyroidism may be related in part to such factors as security, frustration, violent emotional trauma and infection. Case 5 is illustrative.

Case 5.—T. W., aged 42, had an only son who was a navigator in the air force. He was stationed near home and came in every week end. While home on furlough, he received word that he was about to be transferred south, from which points, of course, he was led to believe that he would be sent across shortly. The last day of the furlough found the worrisome mother with swollen upper eyelids. This was at the end of January 1944. We saw her first on Feb. 8, 1944. With the exophthalmometer at 104 mm., her exophthalmos measured 20.5 mm. in each eye. She had early signs of hyperthyroidism. One month later, with the same base line the measurements were 22.5 mm. for each eye and on March 21 they were 23.5 for the right eye and 23 mm. for the left eye. Her basal metabolic rate was + 45 per cent (see case 3).

Bilateral paresis of the inferior oblique muscle is a rare complication following thyroidectomy in which, inadvertently, some of the parathyroid glands have been removed. No similar account could be found in the literature.

CASE 6.—V. C. had a basal metabolic rate of 45 per cent above the average normal, with symptoms of hyperthyroidism. A subtotal thyroidectomy was done on June 7, 1944, after which paralysis of the vocal cords and tetany resulted. The ionized calcium fell to 3 mg. (normal 4.8 to 6.3 mg.) per hundred cubic centimeters. She complained of diplopia. Ophthalmologic examination disclosed bilateral paresis of the inferior oblique with pseudoptosis. Her measurements in the primary position at 13 inches (33 cm.) were 4△ of esophoria and 5△ of right hyperphoria, and at 20 feet (6 meters), 7△ of esophoria and 1½△ of right hyperphoria. By December the squint had considerably improved, and her last examination, on Feb. 7, 1945, showed orthophoria for distance and left hyperphoria of 2△ for the 13 inch distance. On looking up and to the right she had right hyperphoria of 4△, and on looking up and to the left, left hyperphoria of 6△, at 13 inches. No patch for the eye was necessary at this time.

Cataracts have frequently been described following tetany due to parathyroprivia, but a nuclear lesion such as must have been present in this case has not previously been described. The serum calcium of the patient is now normal. The patient was treated with calcium gluconate, preparations of vitamin D and dihydrotachysterol.

CONCLUSIONS

In 21 of 22 patients with hyperthyroidism, pupillographic examination revealed a redilation block. This is ascribed to a hypothalamic origin and lends the first tangible evidence to the confirmation of Marine's hypothesis.

In our hands, the administration of neostigmine bromide, a preparation of vitamin E and pyrodoxine, failed to reduce exophthalmos.

The administration of iodine orally and pregnancy may occasionally result in regression of exophthalmos.

If vision is impaired because of involvement of the optic nerve in patients with thyrotropic exophthalmos, complete uncapping of the optic foramen should be included in the decompression.

108 East Sixty-Sixth Street (21).
45 Gramercy Park North.
865 Park Avenue.

CYCLOPIA

SAMUEL GARTNER, M.D.
NEW YORK

CYCLOPS is a fetal monstrosity with a single central eye. Some reports of this interesting anomaly have been made, but relatively few have included detailed studies of the eyes. Because of the interesting anomalies observed in 2 cases of cyclops, this report has been prepared. The bibliography was recently reviewed by Krafka [1] and Kindred,[2] and an extensive study was made by Adelmann.[3] This malformation was described in the mythology of the ancient Greeks in a race of giants called cyclopes. They were destroyed by Apollo, who was angry at them for forging the thunderbolt that killed his son Aesculapius, the great physician.

Cyclopia is a congenital anomaly but is not hereditary, since life is impossible; in the usual case the child is born dead or dies soon after birth, so that no cyclops has ever reproduced. A familial incidence has not been reported, except by Klopstock.[4]

The development of cyclopia depends on local factors acting on the midline structures of the face at or before the time of development of the anlagen of the eyes. This has been demonstrated in the artificial production of cyclopia in lower forms by Dareste,[5] in 1877; by Stockard,[6] in 1909; by Loeb,[7] in 1915, and by Mangold,[8] in 1931.

The striking feature is the replacement of the normal two eyes by a single median eye. The nose is usually anomalous and is either

This work was done under the William L. Hernstadt Fund at Montefiore Hospital for Chronic Diseases.

1. Krafka, J.: Cyclopia and Arhinia: New Concept, Arch. Ophth. **33**:128 (Feb.) 1945.

2. Kindred, J. E.: Cyclopia Completa and Arhinocephalia Completa with Umbilical Hernia in a Full Term Child: Report of a Case, Arch. Ophth. **33**:217 (March) 1945.

3. Adelmann, H. B.: The Problem of Cyclopia, Quart. Rev. Biol. **11**:161 and 284, 1936.

4. Klopstock, A.: Familiäres Vorkommen von Cyklopie und Arrhinencephalie, Monatschr. f. Geburtsh. u. Gynäk. **56**:59, 1921.

5. Dareste, C.: Recherches sur la production artificielle des monstruosities, en essais de tératogénie expérimentale, Paris, 1877.

6. Stockard, C. R.: The Artificial Production of One Eyed Monsters and Other Defects Which Occur in Nature, by the Use of Chemicals, Anat. Rec. **3**: 167, 1909.

absent or replaced by a proboscis-like structure located above the eye. The cyclopean eyes described in the literature were not all truly single eyes, as actually the single median eye is the rarest form; most of them were partially fused double eyes. One of my specimens had a perfect single eye; the other had a fused double eye. Both these specimens passed through several hands before reaching me, and I regret my inability to obtain any significant history.

DESCRIPTION OF SPECIMENS

CASE 1.—This specimen was a true cyclops, with a single median eye located in the middle of a hideous face. The chin was very short and the upper lip

Fig. 1.—Cyclops with a single central eye, a proboscis above and no nose.

unusually long, extending right up to the eye without any intervening nose. Above the eye was a strange-looking proboscis with a blind central opening, which was a vestigial nasal passage and in general resembled a pig's snout. The hair line came low down, close to the proboscis.

The hexagonal lid fissure was wide open, and the lid had insufficient tissue to draw over the eyes. The upper lid border was continuous. The lower lid border was interrupted in the middle and was replaced by a small conjunctival fold. The separation of the lower lid formed the only bilateral structure about this eye. There was no sign of any puncta or nasolacrimal passages. The cornea

7. Loeb, J.: The Blindness of the Cave Fauna and the Artificial Production of Blind Fish Embryos by Heterogenous Hybridization by Low Temperatures, Biol. Bull. **29**:50, 1915.

8. Mangold, O.: Das Determinationsproblem: III. Das Wirbeltierauge in der Entwicklung und Regeneration, Ergebn. d. Biol. **7**:193, 1931.

was normal. The iris was short, stubby and rudimentary in development, with vascularized pupillary membranes bridging the pupillary zone. Some anomalous ciliary processes were observed on the posterior surface of the iris (fig. 3).

The lens was normally developed, but around the lens was a cellular membrane with many thin-walled blood vessels, which connected with the pupillary membrane. This was the remains of the tunica vasculosa lentis, which normally appears for a period during fetal life and is often observed in premature infants.

Fig. 2 (case 1).—Cyclopean eye. × 8.

The retina was divided into two main zones, with notable differences between them. In the first zone there was well developed retina, with pigment epithelium and choroid beneath it. The second zone extended over a considerable area at the posterior pole and was characterized by absence of pigment epithelium and a conspicuous change in the choroid, which was replaced by a layer of delicate connective tissue with few vessels. The choriocapillaris and the lamina vitrea had disappeared where the pigment epithelium was absent. The retina associated with this area was poorly developed and had a small cellular content, no rods or cones and many irregular rosettes. Rosettes were present in both portions of the retina, but where the pigment epithelium and the normal choroid underlay the retina the rosettes were large and cellular and formed complete tubes, lined with five to ten cells. In the area without pigment epithelium and with a poorly developed choroid the rosettes were smaller, had fewer cells and did not form

complete tubes. In the periphery of the retina, especially in the superficial layers, were many cystic spaces. The rest of the retina presented many variations; one portion had the normal layers, while another contained many rosettes, which disturbed the orderly arrangement of the retina.

The rosettes were tubes formed by walls varying from five to ten cells in thickness; they were mainly circular, but many were longitudinal and some irregular. The rosettes were predominantly in the internal nuclear layer, and a few were present in the external nuclear layer. The part of the retina in which

Fig. 3 (case 1).—Iris with pupillary membranes and tunica vasculosa lentis. × 38.

rosettes formed in the external nuclear layer was further characterized by absence of rods and cones in the affected portions.

Rosettes were more numerous in the area without pigment epithelium and normal choroid, but there the cells forming their walls were only four to six cells deep and were not so tightly packed. Rosette formation has been found as a temporary phenomenon early in the human embryo and in the retina damaged by irradiation during fetal life, as reported by Goldstein and Wexler.[9] Another type of rosette is observed in retinoblastoma. Rosettes form as a result of an

9. Goldstein, I., and Wexler, D.: Rosette Formation in Eyes of Irradiated Human Embryos, Tr. Am. Acad. Ophth. **35**:140, 1930.

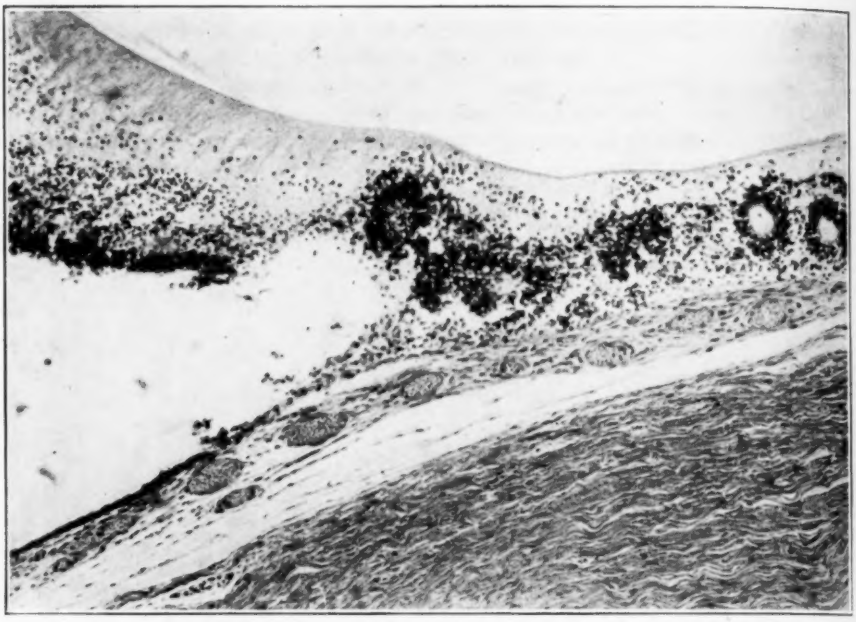


Fig. 4 (case 1).—End of pigment epithelium on the left side of the figure; at this point there is a change in the choroid and retina, with disappearance of the choriocapillaris and the lamina vitrea. × 65.

Fig. 5 (case 1).—Tongue of anomalous retina growing beneath normal retina. × 220.

excess of cells in the nuclear layers, with an infolding of the internal limiting membrane.

Where the pigment epithelium was missing, there was a pronounced change in the choroid and retina. The choroid was replaced by a strand of delicate connective tissue, with few blood vessels and no choriocapillaris or lamina vitrea. The overlying retina had become anomalous and poorly developed, with many poorly formed rosettes and no rods or cones. My study and the investigations of others indicate the interdependence of the pigment epithelium and the choroid in their development. Some authors have suggested that the pigment epithelium dominates the development of the choroid. The absence of a good choroid secondarily affects the nutrition and development of the retina.

Fig. 6 (case 2).—Cyclops.

In another bizarre development (fig. 5), a strip of anomalous retina grew beneath the rods and cones of the more orderly retina beside it.

CASE 2.—The two eyes were fused in one median structure, which was the outstanding feature of the face, as the other features were notable by their absence. There was no nose or mouth. The ears were deformed; they were placed low and curved down into the front of a very thick neck.

The lid fissure was elliptic except at the lateral ends, which came to a point, with a slight fold of the skin. There was a single continuous upper lid. The lower lid was interrupted in the center by a depressed zone, in the middle of which was a small elevation 1.5 mm. in diameter, resembling a nipple.

The eyes were wide open, as the lids were retracted and underdeveloped for a fetus of the size of this specimen. The redundancy of lid tissue that permits easy closure was lacking, and there was no suggestion that these lids had been fused during fetal life. The edges of the lids were round, instead of presenting the

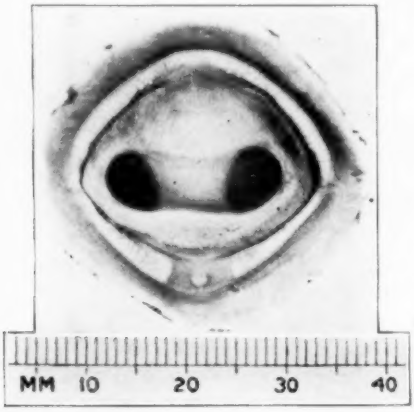


Fig. 7 (case 2).—Cyclopean eye, showing two corneas, with a bridge of sclera between them.

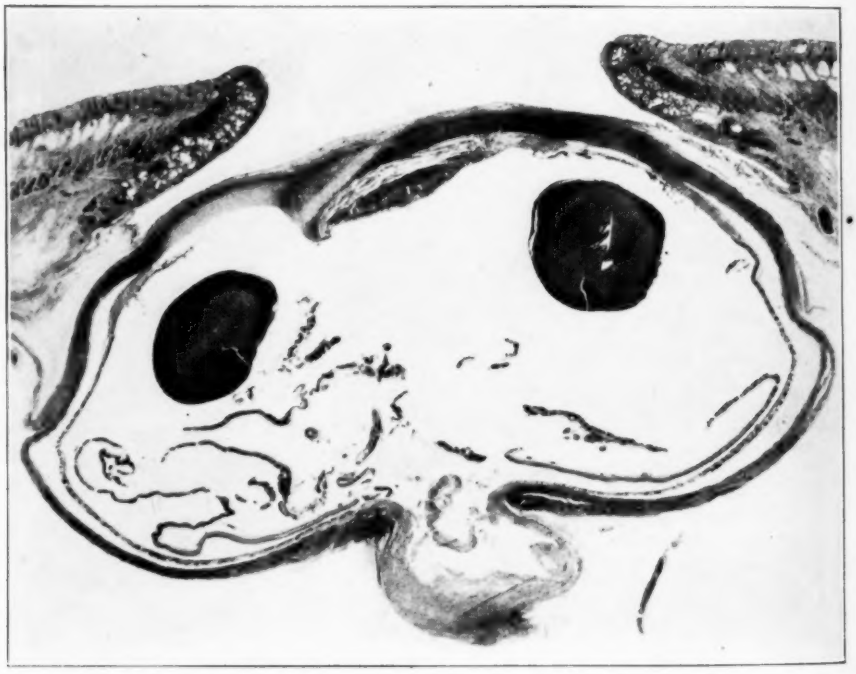


Fig. 8 (case 2).—Section of the cyclopean eye, showing two corneas, with a bridge of sclera, two lenses, a deep pit at the optic disk and a single optic nerve. × 5½.

usual flat end with square edges, and the sharp separation of the two portions of the lid by the gray line was lacking. The lid had many fine hairs, but no well developed eyelashes, at the margin. The normal meibomian glands, as well as the lacrimal gland and a strongly developed orbicularis muscle, were present. No evidence of puncta or lacrimal canaliculi was seen.

The orbit was a single cavity with a bony projection in the lower portion of the wall. In the depth of the orbit was a small central aperture for the single optic nerve. The optic foramen was a vertical oval, 1 mm. wide and 2.5 mm. high. On each side was the opening of the superior orbital fissure, 5 by 2 mm.

This cyclopean eye was a fused double eye, with two distinct corneas, separated by a bridge of sclera, two lenses, two retinas and a single optic nerve. The anterior view of the eye was almost circular, with a diameter of 21 mm. The eye was flattened anteroposteriorly, with a diameter of 10 mm.

The posterior view of the eye was unusual in that nine separate bands of muscle were attached to the globe, of which the lateral and the superior bands

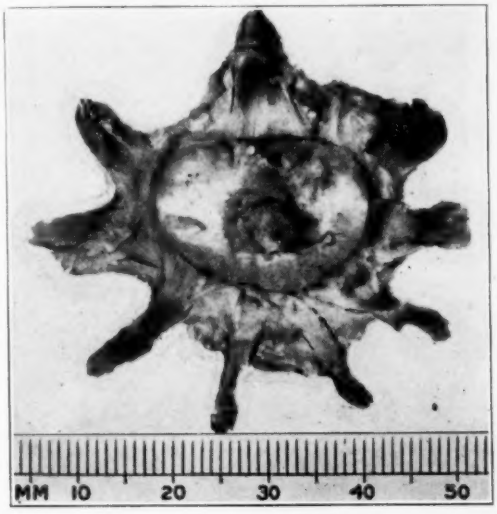


Fig. 9 (case 2).—Posterior view, showing nine muscle bands attached to the eye.

were best developed. All the muscles were attached on nearly one plane, slightly anterior to the equator of the globe. The optic nerve had a very broad attachment to the back of the eye, which tapered soon after leaving the globe.

The conjunctival fornix was shallow and began close to the limbus. On the lid the conjunctiva was one to two layers thick; in the fornix it was about five layers thick, and on the cornea and the sclera it was five to seven layers thick.

The two corneas were similar and very small, being 5 mm. in diameter; they were avascular and separated by 7 mm. of vascularized sclera. At the limbus blood vessels were seen in all layers, being most numerous near the surface. Schlemm's canal was not clearly defined, but there were small vessels filled with blood in the region usually occupied by this canal.

The space between the two corneas was bridged by the sclera, which presented an unusual inward projection of dense connective tissue, as shown in figure 8. Part of this elevation was covered with a rudimentary ciliary body and iris. This projection formed a partial separation between the fused portions of the two eyes.

Behind one cornea was a well developed iris with a central pupil. Behind the other cornea the iris was developed temporally, while on the medial side there was a coloboma, with only a rudimentary iris and ciliary body. The iris had loose connective tissue and many medium-sized blood vessels with very thin walls. The layer of spindle cells was not entirely flat but sent irregular branching formation into the iris. The two pigment layers of the iris were partially separated. The pectinate ligament was well formed where the iris was well developed and was missing where the iris was rudimentary. The pupils were bridged by delicate strands of pupillary membrane. The ciliary muscles were well developed except in the area of the coloboma of the iris, where they were represented by only a few isolated strands of muscle.

The pigment epithelium appeared normal over most of the eye but was missing in some areas. Where it failed to appear the adjacent choroid was

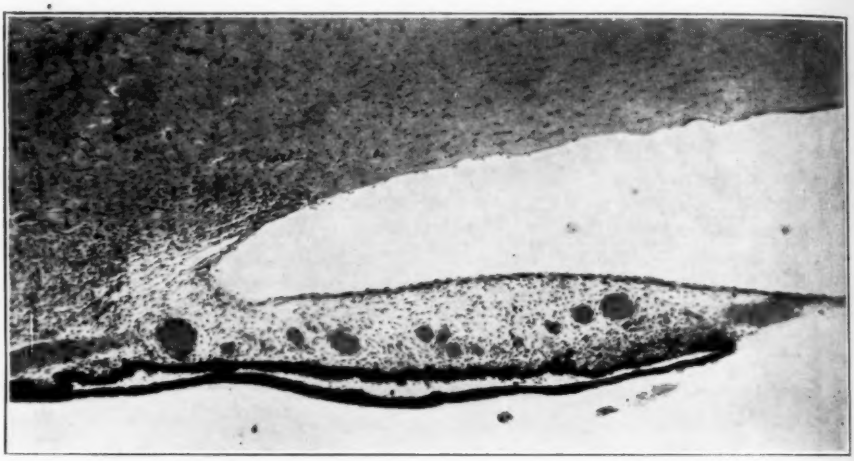


Fig. 10 (case 2).—Iris, showing separation of the pigment layers and pupillary membranes. × 78.

scantily developed; the choriocapillaris and the lamina vitrea were absent, and the overlying retina was poorly developed. This was true except in one area, which will now be described.

The choroid presented an unusual feature in the presence within it of a misplaced island of a retinal type of tissue, beneath the normal retinal layer. This was located near the colobomatous disk and consisted of typical layers of retinal elements and a few rosettes, as shown in figure 11. This remarkable and rare anomaly was described by Coats,[10] who cited a few cases reported by Raab, in 1878; by Deutschmann, in 1881, and by Kundrat, in 1885. This island of retina was buried in the choroid and extended into the sclera. It contained only a few small vessels. Over most of it the pigment epithelium was absent, as well as the lamina vitrea and the choriocapillaris. The true retina above this area was relatively normal except that where the pigment epithelium was lacking there was an absence of rods and cones. The retinal cells in the mis-

10. Coats, B.: On the Occurrence of Misplaced Derivatives of the Secondary Optic Vesicle in Congenitally Abnormal Eyes, Ophthalmoscope **7**:724, 1909

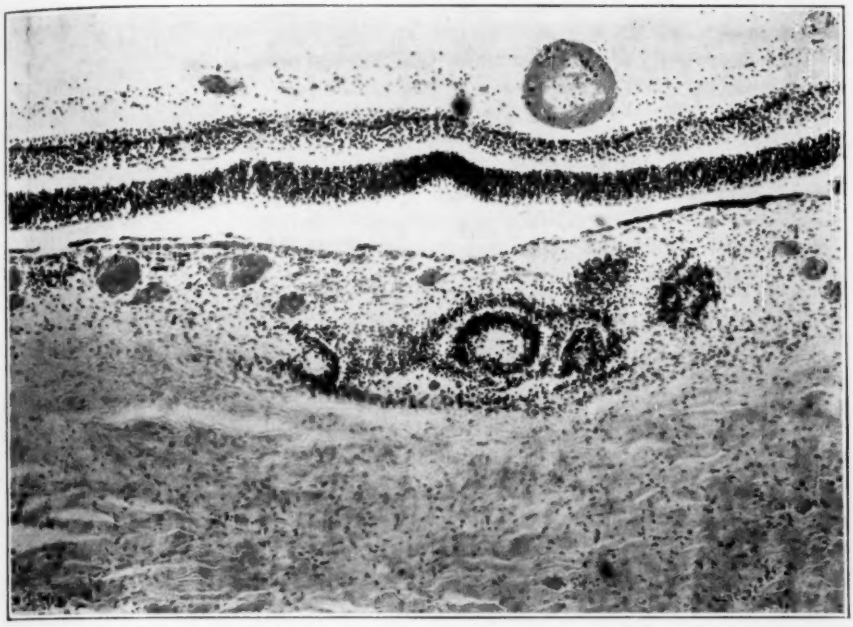


Fig. 11 (case 2).—Island of a retinal type of tissue buried in the choroid and sclera, with absence of the overlying pigment epithelium and a relatively normal retina above. × 56.

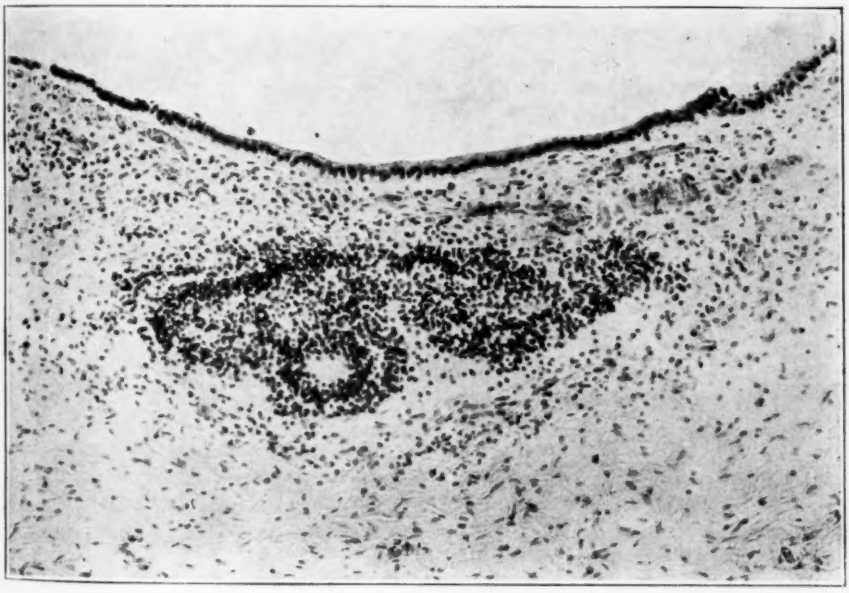


Fig. 12 (case 2).—Edge of the retinal island, showing an overlying layer of pigment epithelium with scant pigmentation. × 77.

placed island were arranged in small layers and rosettes, but no rods, cones or nerve fibers were observed.

Adjacent sections presented other developmental abnormalities which suggest a clue to the nature of this anomaly. As noted before, the pigment epithelium was absent over most of this area. Near the edge of the misplaced island of retina the pigment epithelium reappeared, at first as a nonpigmented, single layer of cells; then succeeding sections showed a thickening of the pigment epithelium, up to seven cells, with scanty pigmentation. The evidence was strongly in support of Coats's theory that the island of retina in the choroid is the result of a metaplastic development of the pigment epithelium, which, like the retina, is neurogenic. The explanation is theoretic but seems plausible.

Fig. 13 (case 2).—Pigment epithelium elevated into many layers near the retinal island. × 31.

The retina in the preparation was somewhat distorted, but there evidently were two complete retinas. The two layers of retina in the center had been somewhat disturbed in the preparation of the specimen. Other cases of cyclops with a single scleral cavity and two retinas, similar to this one, have been reported.

The retina for the most part was developed in a normal fashion except for a paucity of ganglion cells, and these were small; there were a few nerve fibers. Also, there were a number of areas with rosettes, apparently derived from cells of the internal nuclear layer. The rosettes rarely occurred singly but tended to appear in groups of two to five in any one section. When they appeared, they encroached on the neighboring layers and thickened the retina.

In those areas in which the pigment epithelium was lacking the rods and cones were absent, even when the rest of the retina was normally developed.

There were many fresh hemorrhages in the retina, which were probably the result of birth trauma and were similar to the hemorrhages often seen in the newborn.

The region of the disk had a deep, wide excavation, which had the shape of a flask, with a narrow opening. The pit was 3 mm. deep, 4.5 mm. at its widest part and 2 mm. at its neck. Extending into its walls was a continuation of choroidal and retinal structures, which had undergone degeneration or maldevelopment. In the deeper part a thin bundle of atrophic nerve fibers appeared.

SUMMARY

Two cases of cyclops are reported. In 1 case the eye was a true single median eye; in the other, a fused double eye. Both were located in the center of the forehead and presented interesting anomalies.

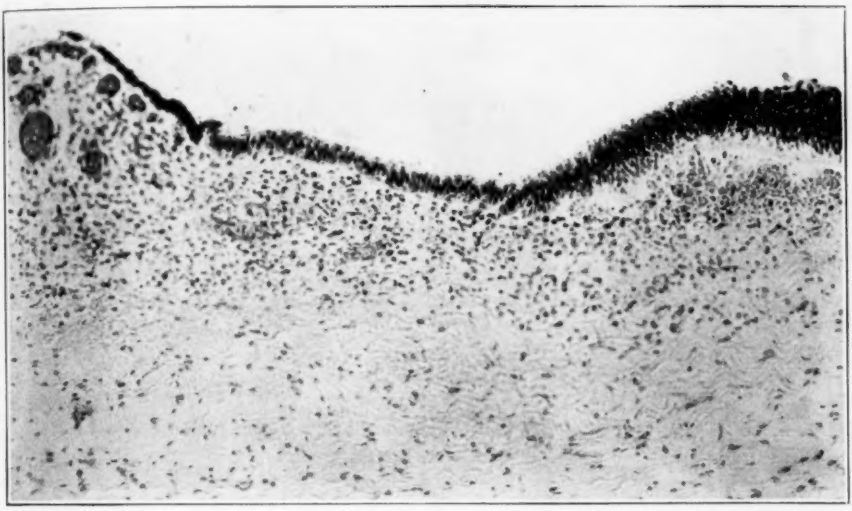


Fig. 14 (case 2).—Higher magnification of a portion of figure 13, showing layers of pigment epithelium with scant pigmentation. × 70.

The importance of the pigment epithelium in the development of the choroid, as well as its influence on the retina, is indicated by this study.

In both cases the absence of pigment epithelium was associated with almost complete absence of the choroid, the choriocapillaris and the lamina vitrea and by maldevelopment of the overlying retina.

In 1 case a misplaced island of retina was observed buried in the choroid and sclera, in an area where pigment epithelium was lacking. Some proof was found that this anomaly was due to metaplastic development of the pigment epithelium into a retinal type of structure.

Dr. B. S. Kramer and Dr. M. Chamlin furnished these specimens, and Miss Hilda Bergen made the microscopic preparations.

521 Park Avenue (21).

Obituaries

ROBERT K. LAMBERT, M.D.
1898-1946

In the untimely death of Dr. Robert K. Lambert, at the age of 47, an inspiring colleague and a treasured friend was lost. He was born in New York city, with a distinguished background. His father was a brilliant physician and his mother a gifted musician. Music and painting became his hobbies. His devoted wife, Gerda, and his daughter, Patricia, survive him.

At Columbia University, Professor MacGregor excited Dr. Lambert's interest in the biologic sciences. After receiving the degree of Bachelor of Arts in 1918, he attended the College of Physicians and Surgeons and obtained his degree of Doctor of Medicine in 1922. After a two year internship in medicine at Mount Sinai Hospital, he sailed for London for a year of study and research under the famous physiologist, Prof. Ernest Starling. On his return to New York, he engaged in general practice and taught physiology at Columbia University. He began his ophthalmologic career in 1928 with a residency in ophthalmology at Mount Sinai Hospital under Dr. Julius Wolff.

He was awarded the DuBois Fellowship at the Presbyterian Hospital Institute of Ophthalmology, where he served for two years under Dr. John M. Wheeler, who had recently become professor of ophthalmology.

Dr. Lambert spent five years in the New York Eye and Ear Infirmary, where he became assistant surgeon in the clinic of Dr. Clyde E. McDannald. His association with Montefiore Hospital began in 1933; by 1940 he was an attending, and at the time of his death consulting, ophthalmic surgeon. Montefiore Hospital is greatly indebted to him for developing the ophthalmic department and founding a laboratory for research.

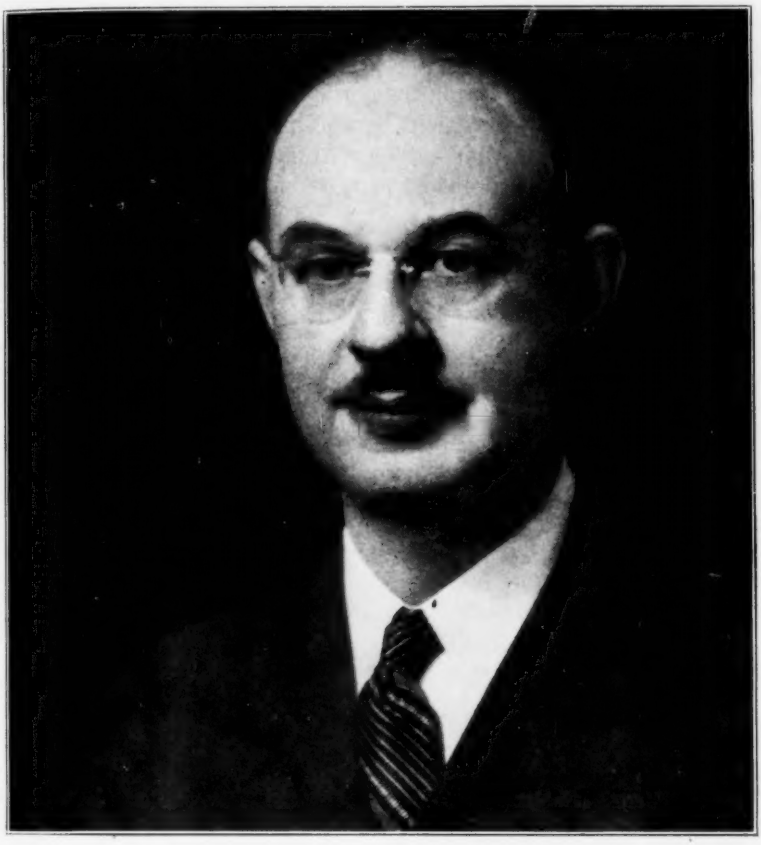
His affiliation with Mount Sinai Hospital was maintained for almost a quarter of a century, from his internship, in 1922, until his death. In 1943 he was appointed attending ophthalmologist to Mount Sinai Hospital.

His pleasant personality and vigorous leadership enriched the scientific achievements of the hospitals he served.

Read at the meeting of the New York Academy of Medicine, Section of Ophthalmology, Dec. 16, 1946.

In 1945 he was appointed clinical professor of ophthalmology at the College of Physicians and Surgeons.

He was a fellow of the New York Academy of Medicine and served as secretary of its Section of Ophthalmology in 1939. He was a fellow of the American College of Surgeons and the American Academy of



ROBERT K. LAMBERT, M.D.
1898-1946

Ophthalmology and Otolaryngology. He was a member of the Association for Research in Ophthalmology, Inc., and the American Association for Advancement in Science.

The end of World War I found him a private in the Army in the S. A. T. C. In World War II he was commissioned a major in the Medical Corps of the Army and served until his health failed.

Although the last year of his life was clouded by the knowledge of his destiny, he spent it without bitterness in hard work and deep study.

Dr. Lambert's ophthalmologic career was based on a broad training in medicine and ophthalmology and was stimulated by his interest in research. Only a portion of his research work was recorded in the seventeen papers he published. His great joy was to guide the men on his staff to research work, in which he gave them the best of training. For that purpose he devoted a good deal of his time, energy and funds. His most enduring memorial will be the strong impression he left on those who worked with him as they hope to carry on in his tradition. A hard worker and a diligent student, he accomplished a great deal in a short lifetime and died at the height of his career, while at the threshold of greater promise.

SAMUEL GARTNER, M.D.

News and Notes

EDITED BY DR. W. L. BENEDICT

GENERAL NEWS

Graduate Course of the Gill Memorial Eye, Ear and Throat Hospital.—The twentieth annual spring graduate course of the Gill Memorial Eye, Ear and Throat Hospital will be held at Roanoke, Va., on April 7 to 12, 1947. One of the guests of honor, Dr. A. J. Ballantyne, Glasgow, Scotland, will speak on April 7, at 8 p. m., on "Clinical Research and Medical Practice." The regular sessions on the eye will be held on April 10 to 12, and the list of speakers is as follows:

Dr. Eugene M. Blake: "Pathology of Glaucoma," "Choice of Operations in Glaucoma," "Unilateral Exophthalmos," "Fundus Changes in Blood Dyscrasias."

Dr. Wiliam T. Hunt: "Essential Points in Routine Refraction," "Ocular Therapeutics," "Management of Cases of Lateral 'Phoria' and 'Tropia,'" "The Near Point Examination."

Dr. Arthur J. Bedell: "Retinopathy of Hypertension," "Fundus Changes in Myopia," "Anomalies of the Fundus," "Differential Diagnosis of Optic Neuritis from Papilledema."

Dr. A. J. Ballantyne: "The Ocular Manifestations of Diabetes Mellitus," "Injuries of the Eye by Blunt Objects," "Birth Injuries of the Eye," "Some Intractable Diseases of the Cornea and Conjunctiva," "The Etiology and Differential Diagnosis of Rapid Loss of Vision," "The Nonsurgical Treatment of Cataract and of the Cataract Patient."

Dr. R. Townley Paton: "Corneal Surgery, with Particular Reference to Corneal Transplant."

Dr. E. G. Gill: "Surgery of the Eye."

Dr. William P. Beethan: "Surgery of the Eye," "Diabetic Retinopathy," "The Management of Some of the External Diseases of the Eye," "Keratoconjunctivitis Sicca," "Crystalline Lens in Diabetes."

Dr. Bernard Samuels: "Histology of the Eyeball, with Special Reference to Inflammation and Surgery."

Dr. Raymond E. Meek: "Detachment of the Retina and the Surgical Treatment," "Minor Surgery of the Eyelids and Conjunctiva," "Cataract Extraction," "The Surgical Management of Crossed Eyes."

Annual Postgraduate Course in Ophthalmology and Otolaryngology.—The thirteenth annual postgraduate course in ophthalmology and otolaryngology was given in Charlottesville, Va., Dec. 9 to 12, 1946. The lectures and clinics were held in the amphitheater of the University of Virginia Department of Medicine.

The lecturers and the subjects were as follows:

Dr. Bernard Samuels, assisted by Dr. E. Burchell: "Sympathetic Ophthalmitis and Tuberculosis of the Globe; Pathologic Conditions of the Fundus Seen with the Ophthalmoscope; Perforating Wounds of the Globe."

Dr. Alan C. Woods: "Ocular Manifestations of Congenital Syphilis; Ocular Manifestations of Acquired Syphilis; Ocular Brucellosis."

Dr. A. D. Ruedemann: "Surgical Correction of Eye Muscle Errors; Treatment of Cataract; Full Eye Plastic Implant."

Dr. S. Judd Beach: "Hysterical Amblyopia with Reference to Confused Diagnosis; Routine Examination of the Eye; Refraction."

Sanford R. Gifford Memorial Lecture.—The third annual Sanford R. Gifford Memorial Lecture was given at the Murphy Memorial Auditorium, 54 East Erie Street, Chicago, on Jan. 20, 1947, by Dr. Frederick C. Cordes, of San Francisco. The title of his address was "Types of Congenital Cataract."

SOCIETY NEWS

Association for Research in Ophthalmology.—The next meeting of the Association for Research in Ophthalmology will be held in the auditorium of the Atlantic City Junior High School, Ohio and Pacific Avenues, Atlantic City, N. J., entrance on Pacific Avenue, on Tuesday, June 10, 1947.

Washington, D. C., Ophthalmological Society.—The Washington, D. C., Ophthalmological Society held its regular meeting on Monday, Jan. 6, 1947, at the District of Columbia Medical Society Building, Washington, D. C.

The guest speaker for the evening was Dr. Charles E. Iliff, of the Wilmer Ophthalmological Institute, Johns Hopkins University. His subject was "Beta Irradiation in Ophthalmology."

A case presentation was given by Dr. M. Noel Stow on "Pseudoxanthoma Elasticum with Angioid Streaks: The Syndrome of Grönblad and Standberg," and 2 case presentations were made by Dr. Ralph N. Greene Jr., 1 on "Possible Tumor of the Macula" and the other on "Multiple Cholesterol Deposits in the Retina." Dr. Edward J. Cummings spoke on "Epithelioma of the Lid," and Dr. A. J. Delaney, on "Pigment Proliferation in Benign Melanoma."

The meeting was then adjourned until February 3, when a special meeting is to be held with the W. Thornwall Davis Post-Graduate Course in Ophthalmology (George Washington University School of Medicine).

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Blind

THE INCIDENCE AND CAUSES OF BLINDNESS IN THE BRITISH COMMONWEALTH. ARNOLD SORSBY, Brit. M. J. 2: 557 (Oct. 27) 1945.

This paper is the report of a painstaking and laborious investigation to determine the number of blind persons, the causes of blindness and the prevention of blindness in the British Commonwealth. The article cannot well be abstracted and should be read in the original. A summary follows.

The number of blind in the British Isles is not less than 90,000 and is likely to exceed 100,000. In the white population of the Dominions it is between 40,000 and 50,000. In the native population of the British possessions in Africa, Asia and Indonesia it is considerably more than 10,000,000. There has been a marked decline in the incidence of blindness in childhood in England and Wales during the past twenty-one years, but there is no evidence that there has been any substantial decrease in the older age group. Before long the decline in the incidence of blindness in childhood will come to an end, as already about 65 per cent of all blindness in children is due to congenital and genetic defects, not readily amenable to treatment. With the rapid elimination of blindness due to infectious disease, intensive research in the problems of genetic disease, maternally transmitted infections, cataract, glaucoma and the pathology of senescence has become an immediate task if the incidence of blindness in England and Wales is to be reduced. In the native population of the British possessions the incidence of blindness could be reduced immediately and effectively by the organization of facilities for the intensive exploitation of the sulfonamide compounds and penicillin in the treatment of the widely prevalent ocular infections.

ARNOLD KNAPP.

Conjunctiva

A CORNEAL GRAFT OPERATION FOR RECURRENT PTERYGIUM. J. L. REIS, Brit. J. Ophth. 29: 637 (Dec.) 1945.

In cases of recurrent pterygium Reis first does a modified McReynolds operation. A superficial corneal layer is then obtained from an enucleated eyeball. The graft is dissected after its margins have been delineated by two parallel, superficial incisions. The size of the graft depends on the extent of the denuded cornea to be covered and will, therefore, vary from 3 to 5 mm. The graft is transferred on the knife blade and slid onto the cornea of the recipient. Then the conjunctival flap is raised slightly with opened forceps and the graft is slid underneath. It is not essential that the conjunctival flap should cover the whole of

the corneal graft. The eye is dressed with calcium penicillin–sulfathiazole powder dusted into the conjunctival sac.

The article is illustrated. W. ZENTMAYER.

Cornea and Sclera

DENDRITIC KERATITIS ASSOCIATED WITH CHRONIC MALARIA. R. D. HARLEY and R. F. KAISER, Am. J. Ophth. **28:** 1309 (Dec.) 1945.

Harley and Kaiser stress the importance of dendritic keratitis as a diagnostic indication of malaria and report 3 cases in which the plasmodium was found. W. S. REESE.

ANATOMIC CLASSIFICATION OF FAMILIAL CORNEAL DYSTROPHIES. A. FRANCESHETTI and J. BABEL, Ophthalmologica **109:** 169 (April-May) 1945.

Histologic studies in 14 cases of corneal dystrophy are reported, and on this basis a classification of corneal dystrophies is presented. Two main types can be distinguished: 1. The progressive, noncongenital form, with two main subtypes. (*a*) The "crumb-lace" type characterized by hyaline degeneration of the corneal epithelium and the deposition of a hyaline, basophilic material under the epithelium. In the "lace" type the changes in the cornea are somewhat coarser and deeper than in the "crumb" type. (*b*) A recessive, spotty type, in which all the corneal cells (epithelium, substantia propria and endothelium) show a deposition of granular albuminous material, in addition to the hyaline degeneration. 2. The comparatively stationary, congenital form. In this form no degeneration is present, but the layers are separated with distribution of a granular substance (lipid?) in the cells of the stroma. The inheritance is generally recessive in these cases, and the changes in the corneas resemble, both clinically and histologically, the alterations in the corneas in lipochondrodystrophy. F. H. ADLER.

HERPETIC KERATITIS: A LABOR ACCIDENT. J. SELLAS and J. CASANOVAS, Arch. Soc. oftal. hispano-am. **4:** 262 (April) 1945.

The authors accept the traumatic origin of herpetic keratitis; in their experience, however, it seldom occurs. Among 20,000 cases of industrial injury to the eye only 6 instances have been recorded. They describe these cases and discuss Grutter's views with respect to trauma as an etiologic factor in this condition. The authors express the opinion that if herpetic lesions appear in less than two days after the alleged injury they should not be considered of traumatic origin. If the lesions make their appearance a week after the accident, all circumstances present should be evaluated. If proved serious ocular trouble develops during the period between the date of the accident and the day on which the diagnosis of herpes is made, the case should preferably be accepted as of traumatic origin.

H. F. CARRASQUILLO.

General

STATISTICAL ANALYSIS OF 1,000 CONSECUTIVE NEW EYE PATIENTS. A. DERÖTTH, Am. J. Ophth. **28:** 1329 (Dec.) 1945.

This analysis is concerned mainly with refraction, the findings indicating the superior skill of ophthalmologists over optometrists and the necessity for examination of the eye by a physician.

W. S. REESE.

BIOMICROSCOPY OF THE EYES IN EVALUATION OF NUTRITIONAL STATUS: CORNEAL VASCULARIZATION. R. K. ANDERSON and D. F. MILAM, J. Nutrition **30:** 17 (July) 1945.

In a survey of the nutritional status of a rather large population group, no correlation could be found between corneal invasion and the level of riboflavin in the diet. There was also no correlation with other signs suggestive of riboflavin deficiency.

Corneal invasion was found to be much more frequent in the white race than in the Negro race.

W. ZENTMAYER.

General Diseases

OCULAR FINDINGS IN TROPICAL TYPHUS (TSUTSUGAMUSHI OR JAPANESE RIVER FEVER). E. A. DONEGAN, Brit. J. Ophth. **30:** 11 (Jan.) 1946.

A total of 101 cases of tropical typhus are described with respect to their salient features. Four of these were fatal. In the acute stage there was conjunctival hyperemia. The optic disk showed hyperemia, with an overlying central haze in the vitreous and blurring of the margins of the disk, often accompanied with swelling of the disk. While haze in the vitreous, taken as a more reliable sign of optic disturbance, occurred in 32 cases, only 2 cases of atrophy of the optic nerve were seen, in 1 of which the serum gave a strongly positive Kahn reaction. In many cases signs of descending neuritis, as described by von Graefe, were present. The signs disappeared without any residual damage to the optic nerve of the retina.

The interpretation placed on the ocular signs is that of a vascular upset, and not of neural or neurologic involvement through invasion of the nerve tissues by the rickettsial bodies.

W. ZENTMAYER.

TEMPORARY CATARACTS IN DIABETES. R. D. LAWRENCE, Brit. J. Ophth. **30:** 78 (Feb.) 1946.

Lawrence observed 2 patients with diabetes in whom cataracts were seen both to form and to clear up in a previously normal lens. Both patients were myopic but had otherwise normal eyes when first seen for diabetes. Both had high blood sugar but no ketosis or signs of body dehydration. In both cataract developed at a stage of much improvement in the diabetes. In the first patient the cataracts first appeared about the sixteenth day of treatment with insulin and lasted three weeks. The cataracts of the 2 patients were similar in their dark rosette appearance and in occupying the central portion and the upper

quadrant of the lens. As these cataracts can be produced both by severe diabetes and by its treatment, the only common causal factor that suggests itself to the author is a change in hydration, both dehydration in progressively increasing diabetes and rehydration under treatment. The literature is reviewed. The article is illustrated.

W. ZENTMAYER.

BILATERAL OPTIC ATROPHY AS A SEQUELA TO THROMBOCYTOPENIC PURPURA. P. V. CARRELI and J. P. CANGELOSI, J. A. M. A. **129:** 550 (Oct. 20) 1945.

A boy aged 6 years had uncontrollable epistaxis following an infection of the upper respiratory tract. A diagnosis of purpura hemorrhagica following infection of the upper respiratory tract was made. During the second week of hospitalization sudden blindness occurred. There was doubtful light perception in both eyes. The pupil was dilated and did not react to stimulation with light. Examination of the right eye showed ecchymotic spots on the lids, slight exophthalmos and limitation of ocular movements. In the left eye there were a staining infiltrate of the cornea at 5 o'clock and slight blurring of the margins of the optic disk with a retinal hemorrhage. A splenectomy was done. The liver was large. The child continued to improve, and when she was last examined there was bilateral atrophy of the optic nerve with doubtful light perception. The authors consider the case of interest because of the rare occurrence of bilateral atrophy of the optic nerve as a sequel to thrombopenic purpura. Splenectomy performed during the quiescent stage of the disease produced almost immediate return of the blood picture to normal, and the ocular condition is still unchanged twenty months after the onset of the disease.

W. ZENTMAYER.

Hygiene, Sociology, Education and History

GRADUATE TRAINING IN OPHTHALMOLOGY. H. S. GRADLE, Am. J. Ophth. **29:** 24 (Jan.) 1946.

Gradle gives a brief history of graduate training in ophthalmology in the United States and pleads for a "third level" of university training, particularly as it pertains to medicine and the medical specialties. This level should cover the period between completion of the general internship and the completion of training required by the special boards. This gap should be filled under university jurisdiction, and a certain degree of uniformity in ophthalmic training on a nationwide basis should be introduced.

W. ZENTMAYER.

Injuries

WAR SURGERY OF THE EYE IN FORWARD AREAS. E. C. ZORAB, Brit. J. Ophth. **29:** 579 (Nov.) 1945.

The working of the ophthalmic unit is described. The method of choice for induction of anesthesia was continuous pentothal drip com-

bined with instillation of cocaine drops in the eye, morphine and scopolamine premedication and continuous administration of oxygen via an intranasal pharyngeal tube.

Perforating wounds of the globe were the commonest type of injury requiring surgical treatment. Those produced by foreign bodies composed the majority. Analysis of the major operations performed during a year in the forward areas is given in detail, showing the relative frequency of various types of ocular injuries. The surgical procedures adopted in dealing with various ocular injuries are outlined.

W. ZENTMAYER.

OPHTHALMOLOGY IN THE BRITISH NORTH AFRICAN AND CENTRAL MEDITERRANEAN FORCES. B. W. RYCROFT, Brit. J. Ophth. **29:** 594 (Nov.) 1945.

This account of the ophthalmic services of the British forces in the Western Mediterranean Theater covers a period extending from November 1942 to November 1944 and includes the campaigns in North Africa, Sicily and Italy.

The article is difficult to abstract. In the treatment of the socket, the use of firm petrolatum packs was thoroughly discouraged, but the elevation of the upper lid by straps of adhesive plaster so as to allow air to circulate within the socket represented an advance in ophthalmic treatment. It was essential in the early stages in cases in which the lid and orbit were wounded to separate the raw surfaces by a strip of petrolatum gauze; otherwise, lid and socket became firmly adherent by the time the patient reached a base hospital.

Except in cases of severe injury, corneal abrasions or ulcer, it is rarely necessary to tie up an eye; flaps or dark spectacles are preferable. When in doubt use a flap.

With all penetrating wounds of the eye the giant magnet is used as soon as possible after the injury. For localization the equatorial ring method serves most purposes.

The Lister frill excision is used for disorganized eyes when seen at an early stage, and at later stages an enucleation, with implantation of a 14 mm. Perspex globe in Tenon's capsule, is carried out. The old evisceration operation is practically never done, and the usual method of enucleation alone is becoming infrequent

W. ZENTMAYER.

EXPERIENCES WITH THE GIANT MAGNET AND METALLIC INTRAOCULAR FOREIGN BODIES IN RECENT BATTLE CASUALTIES. R. E. WRIGHT and H. A. G. DUNCAN, Brit. M. J. **2:** 658 (Nov. 18) 1944.

This is a report of observations showing that the intermittent application of the giant magnet at a number of sittings succeeded in moving a feebly magnetic particle. The authors note that a small magnetic foreign body or a larger feebly magnetic particle may behave as a nonmetallic body for a considerable number of applications and be labeled as such. From the case reported the following lessons are deduced: The posterior route is usually the best for foreign bodies situated in the posterior segment. The shortest route to the exterior is probably the best unless this drags the particle through a structure of greater importance than the one in which it is lodged. To work well

behind the equator, a beak-shaped magnet terminal is essential. The removal of small metallic intraocular foreign bodies of feeble magnetism depends on the patience and perseverance of operator and patient. It is important to remember that the frequent applications of the giant magnet increases the magnetism of feebly magnetic alloys. The application of a surface diathermy terminal to the sclera in the neighborhood of the metallic intraocular foreign body is likely to produce an uncontrollable reaction; so it is better to apply diathermy to the neighborhood of the scleral wound after the foreign body has been extracted.

ARNOLD KNAPP.

MANAGEMENT OF INCREASED INTRAOCULAR PRESSURE FOLLOWING WAR TRAUMA (SECOND COMMUNICATION). S. KALFA, Vestnik oftal. **24:** 55, 1945.

When glaucoma is a result of anterior synechia, surgical intervention should be early in order to prevent permanent adhesions of the angle of the anterior chamber. The prolapsed iris should be excised and the wound covered after the method of Kuhnt for prevention of infection. The best measure of combating this type of glaucoma is Filatov's operation, "iridectomy duplex," which consists in a double incision of the cornea at the base of the synechia with the Graefe knife. A double iridectomy is done at these places. If the anterior chamber is shallow, an iridectomy ab externo is preferred.

The delay in restoration of the anterior chamber after injury is due either to fistula formation or to edema or hemorrhage in the vitreous. A prolonged delay in reformation of the chamber in the presence of an inflammatory process leads to formation of adhesions between the base of the iris and the cornea. The fistula should be closed after the method of Kuhnt, an iridectomy and cauterization of the edges of the fistula being done prior to it. If there is no fistula and the intraocular tension is increased, a posterior sclerectomy is performed with Elliot's trephine about 7 mm. from the limbus, at the external margin of the superior rectus muscle. A bead of vitreous usually appears in the trephine hole; this is cut off with scissors. The anterior chamber is usually restored on the day following this procedure.

Extracapsular extraction leads to secondary glaucoma more frequently than intracapsular extraction, as the cortical masses may block the angle of the anterior chamber. Cyclodialysis is the method of choice.

Glaucoma after uveitis can be treated without operation, employing tissue therapy, miotics (with caution), mydriatics and retrobulbar injections of a 2 per cent solution of procaine hydrochloride. In cases of iris bombée or of occlusion of the pupil, transfixation of the iris after the method of Fuchs is recommended, as it causes little bleeding and the inflammatory symptoms are minimal.

O. SITCHEVSKA.

Lens

CONGENITAL CATARACTS IN SISTERS WITH CONGENITAL ECTODERMAL DYSPLASIA. H. N. COLE, H. K. GIFFEN, J. T. SIMMONS and G. M. STROUD III, J. A. M. A. **129:** 723 (Nov. 10) 1945.

Two sisters aged 10 and 22 months, respectively, had congenital cataracts of the lamellar type, extreme internal strabismus, hypoplasia

of the nails, almost complete alopecia, atrophic nasal mucosa and generalized hypoplasia of the skin. Both children stood heat poorly; both were subnormal mentally, and the older had a dental hypoplasia. Microscopically there was an irregular hypoplasia of the skin and accessory structures—sweat and sebaceous glands and hair. In places all three were completely absent.

Involvement of all ectodermal elements as seen in these sisters is rare if not unique, and the picture presented approaches closely that of congenital ectodermal dysplasia of the anhidrotic type but perhaps would better be classified as a combined ectodermal dysplasia.

The dysplasia of ectodermal elements seen in these sisters with only a suggestive dental abnormality in the father and no other family history is probably "incompletely dominant" in type.

Simmons, in discussion, stated that it had been approximately one and one-half years since the cataracts were operated on. With corrective bifocal lenses, both children walked about freely, in contrast to their being content to sit still before. They recognized household articles and toys by name. The squint was unimproved.

The article is illustrated. W. ZENTMAYER.

COPPOCK CATARACT AND CATARACTA PULVERULENTA CENTRALIS. E. ROSEN, Brit. J. Ophth. **29:** 641 (Dec.) 1945.

Rosen has made photographs with the slit lamp in 3 cases of Doyne's discoid cataract (Coppock). In the first case the opacity was seen to occupy the most central portion of the lens, its center being somewhat transparent. The cataractous disk was made up of tiny white, highly refractile, dotlike deposits, located in the fetal nucleus, with only the lucid interval separating the anterior and posterior portions. The Y sutures were in this same zone and could be made out more or less incompletely. The disk appeared to have a greater posterior than anterior bulge. In some of the spaces between the small white dots were areas which resembled the microscopic vacuoles seen in immature senile cataract. The appearance of the lens in the other 2 cases was similar to that in the first case. W. ZENTMAYER.

DIABETIC NEEDLES. E. ROSEN, Brit. J. Ophth. **29:** 645 (Dec.) 1945.

Rosen describes a lenticular sign which he states has come to be known as the "diabetic needle," or "Roman numeral," sign, consisting of a spoke formation in the periphery of the lens. The needle appears as a linear black streak, no thicker centrally than it is peripherally. This is the most important feature; and even in cases in which there is adult spoke formation in the lens, characteristic of early change in senile cataract, there still may be superimposed on this cataract formation the characteristic "diabetic needle."

The sign is not constant, but when present it is specific for diabetes.

It is best observed when the pupil is dilated and the red reflex is studied with the (indirect) ophthalmoscopic method or with the retinoscope.

A brief résumé of the clinical history of 19 cases, with a drawing of the lenticular changes in each case, is given. W. ZENTMAYER.

Neurology

POLYOPIA AND MONOCULAR DIPLOPIA OF CEREBRAL ORIGIN. M. B. BENDER, Arch. Neurol. & Psychiat. **54:** 323 (Nov.-Dec.) 1945.

The author reviews the literature and discusses in a comprehensive and enlightening manner the factors giving rise to polyopia and monocular diplopia. He reports in detail 4 cases with the experiment and tests used to reveal polyopia and monocular diplopia. To quote directly:

"The first 3 cases described show several things in common, namely, (*a*) scotomas in the fields of vision; (*b*) fluctuation, obscuration or extinction phenomena in the defective fields of vision; (*c*) disturbance in the mechanism of fixation, and (*d*) optical illusions. The fourth case is somewhat different, inasmuch as there were no demonstrable field defects and the double, or false, image was incomplete. Naturally, the first impulse is to attribute all these symptoms to a common cause, but this is possible only from the structural standpoint.

"One may safely assume that the scotomas were produced simply by damage to the calcarine cortex or the optic radiation. Here destruction of tissue produced absence of function. The rest of the symptoms, however, cannot be explained on a structural basis alone. They seem to be an expression of normal functions which become apparent only under pathologic conditions. Fluctuation, obscuration and extinction of visual perception are psychologic phenomena which become evident in patients with diseases of the visual cortex or pathways. This apparent disorder in perception is due to the presence, and not to a lack, of function.

"Disturbances in the mechanism of fixation, as noted in the cases described here, are also expressions of underlying normal functions which are thrown out of equilibrium.

"Fixation is maintained by a constant muscular effort in which the actions of all the ocular muscles are balanced. . . . It is concluded that the rapid and involuntary movements of the eyes produced by faulty fixation tend to stimulate, simultaneously, the original macula and any new maculas which may have been formed as a result of impairment of vision."

S. R. IRVINE.

A CASE OF OCCIPITAL LOBE INJURY. J. MACASKILL, Brit. J. Ophth. **29:** 626 (Dec.) 1945.

A soldier aged 22 was hit on the right side of the back of the head by a bursting shell. Consciousness was never lost, but after the injury he could not see at all to the left side. One week later objects far out on the side could be seen, but he was aware of a nonseeing area toward the center of vision. Three months later there was a healed, depressed wound in the occipital region to the right side of the midline. Both eyes were normal and had full vision. There was a left homonymous hemianoptic scotoma, with steep edges, but the fixation area was spared. The wound in the skull was opened and enlarged to expose healthy dura, the dural scar excised and bone fragment removed from the brain to a depth of 3 cm. The field defects indicated a lesion of the posterior part of the visual cortex mainly on the right side, and the findings at operation form a guide to their correlation.

The initial loss of the whole field on the left side resulted probably from a functional disturbance of all the right visual area of the brain at the time of the injury, and it may be noted that recovery commenced in that part of the field which corresponded to the region farthest from the injury. There was no opportunity to examine the field after operation, but the nature of the injury and the steep edges bounding the scotoma suggested that little, if any, improvement can be expected.

The article is illustrated.

W. ZENTMAYER.

SIXTH-NERVE PARALYSIS AFTER SPINAL ANALGESIA. W. A. FAIRCLOUGH, Brit. M. J. **2**: 801 (Dec. 8) 1945.

After commenting on the scarcity of recent literature on this subject, the author reports that during the past two years he has observed 10 cases. He discusses various theories which have been advanced to account for this lesion and suggests a new theory, which, though not providing the basal cause of paralysis of the sixth nerve, would account for the fact that this nerve so frequently shows signs of injury earlier than any of the other cranial nerves, even without taking into consideration its anatomic disadvantages. The author first speaks of binocular vision and the necessary faculties which are concerned in its maintenance. From a phylogentic point of view, binocular stereoscopic single vision is one of the latest acquired attributes and probably is one of the first to be lost or disturbed under stress. Imbalance and insufficiencies of the ocular muscles, concomitant squint, heterophorias and refraction errors all have a definite bearing on the subject. The author suggests that the common presence of a defect in one or more of the conditions essential for the maintenance of binocular vision and an added toxin will together provide the factors producing the lesion of the abducens nerve.

In none of the 10 cases was the paralysis complete. A toxic drug acting on an unstable binocular function can very probably be the cause of the diplopia and paralysis of the abducens nerve following spinal analgesia. Thus, it will occur in a patient with esophoria, and the esophoria would become a manifest convergent squint with uncrossed double vision. Furthermore, the author thinks that no other theory has been put forward to account for the paralysis of the abducens nerve being so commonly unilateral and only partial.

Of the 10 patients reported on, 9 were examined after they stated that their eyes were again normal. Each showed a degree of esophoria, varying from 1 to 5 prism diopters at 6 meters, and none had exophoria.

The author then discusses the causal theories, the common symptoms, the prognosis and the treatment. The treatment is not very satisfactory, though the inhalation of oxygen has given definite relief in many cases.

During the period under review, spinal analgesia was administered to 2,021 patients, of whom 10 had paralysis of the sixth nerve. The author summarizes the condition as one which is founded on the instability of binocular vision.

ARNOLD KNAPP.

BITEMPORAL HEMIANOPSIA DUE TO TRAUMA. J. BRENTA and P. DANIS, Ophthalmologica **111**: 8 (Jan.) 1946.

Analysis of the cases already appearing in the literature and of a case in the authors' experience leads them to certain conclusions.

They believe that in some cases the direct mechanical effects of the trauma produce a sagittal tear of the chiasm, sometimes including neighboring structures, and that this is the direct cause of the hemianopsia. In other cases some secondary process must be added to the mechanical effects. In a third group of cases it is evident that there is no direct mechanical influence at all but that the hemianopsia is caused by a degeneration of fibers.

F. H. ADLER.

Operations

FASICA-LATA TRANSPLANT FOR RETROTARSAL ATROPHY OF UPPER LID FOLLOWING ENUCLEATION. N. L. CUTLER, Am. J. Ophth. **29:** 176 (Feb.) 1946.

Cutler describes a procedure for restoring the normal fold of the upper lid after enucleation. He creates a tunnel below and following the curve of the brow, through which he pulls the shredded fascia lata. He has used this procedure with 134 patients.

W. S. REESE.

TUBULAR STEM IN OPHTHALMOLOGY. V. FILATOV, Indian J. Ophth. **6:** 23 (July) 1945.

The present article deals mainly with plastic operations using surface tissues and, principally, skin layers. Three fundamental principles of skin plastics are the Hindu method, the Italian method and plastic operations with unattached pieces of skin.

Filatov describes the method and technic of the tubular stem and states that it is a method and, as such, leaves scope for ingenuity of surgeons to devise the best method of achieving the required plastic result.

W. ZENTMAYER.

Orbit, Eyeball and Accessory Sinuses

EXPERIENCES WITH THE SURGERY OF THE ANOPHTHALMIC ORBIT. A. G. DEVOE, Am. J. Ophth. **28:** 1346 (Dec.) 1945.

DeVoe discusses surgery of the socket, especially operative methods for the deformity of sinking or retraction of the upper lid. He stresses the importance of cooperation of the artificial eye maker.

W. S. REESE.

A CASE OF SIDEROSIS BULBI. J. E. L. BENDOR-SAMUEL, Brit. J. Ophth. **30:** 85 (Feb.) 1946.

A man aged 35 complained of pain in an eye which had been blinded about a year before while he was firing a rifle at a "dead" grenade. The iris was discolored, and the cornea was edematous and infiltrated with spots of dark brown pigment. The lens was opaque. Vision was reduced to perception of light, and light projection was faulty. The tension was greatly increased. A roentgenogram showed the presence of an intraocular foreign body; this was removed through a scleral incision. About five weeks later a simple extraction of the cataract was carried out. One month later vision was 6/12. There were deposits of ferrous pigment on the posterior capsule. Discission

of the capsule was performed. The resulting visual acuity was 6/12. The visual field was considerably contracted. The case illustrates the value of surgical intervention for an eye with siderosis bulbi in an advanced state.

W. ZENTMAYER.

SIDEROSIS BULBI: REPORT OF A CASE. A. PAULO FILHO, S. RAFAEL, SEBAS and A. GIARDULLI, Hospital, Rio de Janeiro **28:** 339 (Sept.) 1945.

A man harbored a chip of iron in his eyeball for eleven years before the appearance of siderosis bulbi. The cornea and muscular tissues of the iris did not contain iron pigment. The pigment was selectively located on the retina in the form of accumulations of free pigment in granulations. The iron in the eyeball was ionizable. Paulo Filho and his associates believe that the first change caused by metallic iron is the partial coagulation of the cytoplasm. Later the newly formed granulations of iron pigment cause necrosis of the retinal cells, with consequent blindness.

J. A. M. A. (W. ZENTMAYER.)

Parasites

OCULAR CYSTICERCUS CELLULOSAE: REPORT OF A CASE OF PARASITE IN THE VITREOUS. C. COCKBURN, Brit. J. Ophth. **30:** 65 (Feb.) 1946.

A man complained of a mist before the right eye. About six weeks later a well defined object shaped like a pear leaf with a stem that had a knob at the end like a serpent's head, which was constantly changing its position, was seen entopically.

Ophthalmoscopic examination showed a ring of iris pigment on the anterior capsule of the lens, two lenticular opacities and vitreous haze with many dense, freely moving opacities in the vitreous. In the lower part of the vitreous there was a highly lustrous, almost completely spherical cyst, brilliant blue-green above, passing to a russet brown at the center and shading off to a lemon tint below. The upper periphery was surrounded by a narrow, brilliant golden halo. At the lower margin was the miniature tapeworm, constantly changing its position in a low, swaying movement. The head itself possessed power of movement. At the extreme periphery of the fundus was a large, irregular yellowish area, resembling acute choroiditis. The cyst was removed through a scleral incision. About ten months later the eye was quiet and had good light perception. The hooklets were those of Taenia solium. The article is illustrated.

W. ZENTMAYER.

Society Transactions

EDITED BY DR. W. L. BENEDICT

OXFORD OPHTHALMOLOGICAL CONGRESS
REPORT OF THE THIRTY-SECOND ANNUAL CONGRESS AND A BRIEF HISTORY OF THE CONGRESS

Bernard Samuels, M.D.
New York

July 4-6, 1946

The thirty-second annual Oxford Ophthalmological Congress took place at Keble College, Oxford, England, on July 4, 5 and 6, 1946. Members of the congress, including lady members for the first time, were lodged under the hospitable roof of the college. The scientific proceedings, calling for thirteen papers and four demonstrations, were held in the nearby department of human anatomy, located in the museum of Oxford University.

On Wednesday evening, the third, an informal dinner was served in the Hall of the college, and for the convenience of those who could not arrive in time there was a buffet in the Junior Common Room (all places to older members as familiar as household rooms), where light refreshments were served. In this way, men eager to see one another, after the long war, were given a chance to renew friendships, and those come for the first time were requested to make their presence known to the honorary secretary.

On Thursday morning, the fourth, the day began at 7:30 with a bathing parade, which started at the porter's lodge at the college entrance for Parson's Pleasure, on the meandering, tree-arched Cherwell.

At 10 o'clock the scientific program began. The master, Mr. Philip G. Doyne, whose father had been the first to grace the chair, in a brief address bade the congress a cordial welcome. He called on Mr. Philip Jameson-Evans to open a discussion on amblyopia. This was done under two headings: (1) toxic amblyopia and (2) congenital amblyopia. 1. The thesis was put forward that the toxicity of tobacco is dependent on a process of fermentation in the leaf, and emphasis was laid on the importance of the water content of tobacco and attention drawn to the effect that the metabolism of the liver has in toxic amblyopia. Alcohol and vitamin deficiency were mentioned as accessory factors. 2. The relationship of visual acuity, fusion, stereopsis and fields of vision was made clear, and electroencephalographic findings in cases of congenital nystagmus were correlated with present day theories of vision.

Dr. Dorothy Campbell, the second speaker, restricted her discussion to primary amblyopia. Early amblyopia, congenital amblyopia and amblyopia ex anopsia were defined and critically differentiated from one another. Theories as to the causation of amblyopia were outlined, and methods of detecting and treating it in young children were described.

Mr. Harold Ridley, the third speaker, based his discussion on an interesting series of cases of amblyopia from malnutrition, methyl alcohol and tryparsamide that came under his observation during service overseas.

These three excellent and well delivered essays and the general discussion that followed completed the morning hours.

After lunch the annual group photograph of the members of the congress was taken in "The Quad" of Keble College.

The afternoon session began with a paper by Dr. Bernard Samuels, entitled "Proliferation of the Epithelium of the Lens," in which were described changes in the epithelial system of the lens caused by lesions in other parts of the eye. Dr. J. A. van Heuven's paper, on "Retinal Detachment Following Inflammation," concerned the often overlooked role played by retinitis in the causation of detachment.

The meeting adjourned from the hall of human anatomy to the adjoining scientific museum to witness the scientific demonstrations. Mr. Thomson Henderson explained the anatomic principles on which iridodialysis for glaucoma depends. Mr. J. Cole-Marshall showed sketches of a hole in the macula as it appeared at different times. Mr. Lloyd Johnstone presented 4 patients of the same family with two types of hereditary cataract.

It was then time for the congress to betake itself to Wadham College (whose buildings, dating from 1612, are little changed), there to have tea in "Ruskin's corner" of the gardens, at the invitation of the warden. It is said that the gardens of Wadham, swept by branches of ancient cedars in a setting of holly and giant yews, owe their beauty to the perfect harmony that exists between them and the Jacobean architecture of the buildings. This felicitous occasion will be remembered by many as long as they remember anything.

In the evening the 145 members who had gathered at the congress, being more than had ever met at one time, came out in force to the annual dinner, held in the long and spacious Hall of Keble. The college, built of variegated brick, is modern. Its stated purpose is to provide a training for young men in "the principles of the Church of England." So it happened that England's churchmen, their course run, looked down from paintings exalted on the walls upon a goodly company of the living, who, having ceased from their labors for an interval, presented a scene of happiness and levity. In the course of the dinner, Dr. van Heuven, of Utrecht, Netherlands, rose and in a charming manner presented to the congress a beautiful and fittingly inscribed tile, baked in Dordrecht, as a token of gratitude from Netherland ophthalmologists for the assistance rendered them by their English colleagues during the late war.

On Friday morning, the fifth, the program started with an address by Prof. H. Hartridge on "Recent Advances in the Physiology of Vision," which followed the substance of a paper published in the *British Medical Journal* (1: 637 [April 27] 1946). However, no written language could have equalled words so fluently spoken and so graphically illustrated by free hand drawings, all of which made a difficult subject entertaining and instructive.

This morning was the major one of the meeting, for, after a pause, there was to come the Doyne Memorial Lecture, which was delivered

by Prof. A. J. Ballantyne. He chose for his subject "The State of the Retina in Diabetic Retinitis." He spoke first of the difficulty in defining diabetic retinopathy because of variations in the clinical picture that arise from time to time. These may represent either different stages in the development of the retinal changes or qualitative differences in the character of the diabetes, or they may be due to the influence of complicating factors. Drawing on a large series of diabetic cases of his own, he correlated their clinical and histologic phenomena and traced the relationship of both to the general disorder. Sketches of microscopic specimens and a set of drawings in colors of diabetic fundi, true to nature, gave evidence of the care with which this brilliant discourse was prepared.

The afternoon's session was opened with a paper by Mr. Alex MacRae, entitled "Aspects of Thrombosis of the Central Vein." He cited cases from his practice in which a diagnosis of thrombosis was made and the patient recovered with good vision after prolonged rest in bed. He was convinced that in some of the instances of complete recovery the correctness of the original diagnosis should have been questioned. Mr. John Marshall's paper, on "Sectional Recession and Treatment of Squint," and Mr. O. M. Duthie's paper, on "Convergent Strabismus" each produced lively and prolonged argument, as does most experience with muscle operations whenever it is aired in meeting.

On Saturday morning, the sixth, the master summoned to the Hall a true friend of the congress, Mr. Chesterton, who, since the first meeting, year by year has seen to it that the anatomic department is in readiness. The master presented to Mr. Chesterton an envelope containing an expression of thanks and high regard. Mr. Chesterton, in words that warmed everyone's heart, returned thanks to the congress and, to the regret of all, announced his approaching retirement from the department because of his age.

The annual general meeting was called. The council announced the names of the executive officers for the next year: As master, Mr. F. A. Williamson-Noble, and as deputy master and honorary secretary-treasurer, Dr. F. A. Anderson.

Dr. J. J. Healey, in his paper entitled "Two Cases of Parinaud's Syndrome," took occasion to give a concise and critical review of the syndrome.

Prof. Arnold Loewenstein is to be congratulated on his paper, entitled "Observations on the Blood Vessels of the Retina in Bulk." This represents a fine piece of original research, proving the development of capillaries within the walls of occluded retinal vessels, in an attempt to reestablish the circulation.

Dr. C. L. Schepens, in his paper on "Goldmann's Hemispherical Projection Perimeter," brought out many points of practical use.

It remains to speak of the commercial exhibition, which, as in prewar days, filled the room assigned to it. It was an important and valuable part of the meeting, visited and revisited by all. The old firms from Oxford and Wigmore Streets in London were all represented. The delay in filling orders, the demand for instruments being great and urgent, lay, as in this country, in lack of materials and skilled workmen and in governmental restrictions.

In connection with this report of the first congress in six years not overshadowed by hostilities, it would seem opportune to outline the salient facts that had to do with the inception of an organization that today exerts so important and benevolent an influence. It truly represents the lengthening shadow of one man, Robert Walter Doyne. In 1886 Doyne founded the Oxford Eye Hospital. In 1900, a readership in ophthalmology was made possible in Oxford University through the munificence of Margaret Ogilvie, whose name it officially bears. Doyne received the appointment as the first reader, conjointly with which he became senior surgeon at Radcliffe Infirmary. This venerable charity was founded in 1770, the year before the New York Hospital received its royal charter from King George III. In the minds of Americans the Radcliffe is associated with the name of William Osler, whose memory is there kept fresh by the Osler pavilion.

In 1902, the university, having been convinced by Doyne of the important place that ophthalmology occupies in medicine, instituted a diploma in ophthalmology. This is a diploma conferred on candidates who have passed an examination held by the university after their completion of a course in a recognized school of ophthalmology, such as the one conducted by the Oxford Eye Hospital, the Royal London Ophthalmic Hospital (Moorfields) or the Royal Eye Hospital, in London. Of the twelve months instruction required, it is necessary that the last two be taken at Oxford.

The circumstance that directly led up to the establishment of the congress was a vacation course that Doyne gave for a number of years to ophthalmologists or any others interested in the specialty. The course lasted fourteen days, and at the end of this time lecturers and students were invited to remain for three days to discuss matters gone over and to see patients. Men not connected with giving the course were invited to come and read papers. The course became popular and drew men to Oxford from the Continent, the United States and the Dominions. In retrospect, the three days' conference was the present congress in embryo. It always sat at Keble, and custom, strong in England, exacts that the connection with Keble be continued.

In 1904 the British Medical Association met at Oxford, and, as it happily happened, the section of ophthalmology was housed at Keble and Doyne was appointed chairman. The meeting proved to be so successful scientifically and socially that Doyne, deeming the congress to be worthy of perpetuation, the next year sent out an invitation to members of the British Ophthalmological Society to come to Oxford; and so they and others from many countries, began to come in ever increasing numbers. In 1909, what had been known as the Oxford meeting was dignified with the name of the Oxford Ophthalmological Congress. In Great Britain, as elsewhere, most medical bodies bear a title that suggests that their membership is restricted to a certain locality. Thus, there are the British Ophthalmological Society, the North of England and the Midland Ophthalmological societies, the Irish Ophthalmological Society and the Club of Scottish Ophthalmologists, this last cognomen seemingly putting emphasis on a social, rather than a scientific, purpose. But there is but one congress, the Oxford Ophthalmological Congress, whose membership from all over the world bespeaks its universality. One of its founding members was

Wendell Reber, of Philadelphia, and among the original ten American members were Charles H. May, J. McReynolds, McCluney Radcliffe, Derrick T. Vail and Casey A. Wood. One day Harvey Cushing, on a visit to Oxford, attended unannounced to see for himself how eye men conduct their meetings. The congress is sometimes spoken of as the "Anglo-American Ophthalmological Congress."

The constitution of the congress states that it is for scientific and social intercourse of legally qualified medical practitioners who are interested in ophthalmology. The management is vested in a council, who elect the executive officers. There is no entrance fee or annual subscription, but a contribution is payable on each occasion that a member attends. The master wears the collar of his office, bearing his badge in colored enamel on gold, showing the calabar bean, the pilocarpus leaf and the fruit of Atropa belladonna.

Although the inauguration of the congress may be said to have been the coping-stone in Robert Walter Doyne's professional career, he wrought much more. As a practitioner he was a keen and accurate observer. He contributed no little to the literature of his time. His name is associated with such conditions as Doyne's family choroiditis, Doyne's iritis and Doyne's blepharoconjunctivitis.

In 1916, the year of Doyne's death, which occurred in the prime of his life, the council instituted the Doyne Memorial Lecture and caused a bronze medal to be cast for presentation to each lecturer. In looking over the names of the distinguished recipients, it appears that not all have been ophthalmologists. The allied specialties are represented, for it is the policy of the congress to be kept in touch with those branches of medicine on which ophthalmology is founded.

The fame of the Oxford Eye Hospital has grown side by side with that of the congress. It is an entirely independent unit, run by itself and proud of it. The hospital, with its forty-five beds, is housed in a building and on ground leased from the Radcliffe Infirmary—and this is the only connection between the two. Mr. P. H. Adams succeeded Doyne in charge of the hospital, and since 1941 Prof. Ida Mann has occupied the post. Her status in the university has been raised from that of a readership to that of a professorship.

Oxford was not damaged by "enemy action." Owing to this fact, Professor Mann was able to arrange an uninterrupted course that was designed to fill the needs of ophthalmologists in war and in peace. Among the Americans who came to attend the wartime congresses or to take Professor Mann's course, and who are so kindly remembered, were Colonel Derrick T. Vail and Majors Byron Smith, F. Phinizy Calhoun, Jr., Kenneth Fairfax and Joseph Krug. In 1942 Viscount Nuffield became interested in the Oxford Eye Hospital and gave a donation for the equipment of a research laboratory there. This is housed in a temporary structure in the yard; and, as it is not endowed, in order that it may be fruitful, Oxford University is endeavoring to raise 250,000 pounds, of which 180,000 pounds are in hand.

When one stops to consider why the Oxford Ophthalmological Congress has endured and has increased in membership from 181, at its first meeting, in 1910, to 489 in 1939, certain characteristics of the meetings come to mind. The proceedings are leisurely conducted and are well balanced. The practical surgeon and the research worker may

be assured of hearing something that will be of particular interest. The attitude of those who participate in the discussions is frank and tolerant, which makes for good feeling and friendship. Finally, the seat of the congress is in the stately city of Oxford, which, with its traditions of seven hundred years of learning, has an allure all its own.

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

Brittain F. Payne, M.D., *Chairman*

Milton L. Berliner, M.D., *Secretary*

Regular Meeting, Oct. 21, 1946

INSTRUCTION HOUR

Controversial Points in Ocular Penicillin Therapy. DR. LUDWIG VON SALLMANN.

The mechanism involved in the passage of penicillin across the blood-aqueous barrier and the means of influencing this passage were first discussed, and the following features of surface application were then considered: (1) continuance of penicillin activity in the conjunctival sac after instillation, (2) iontophoresis and (3) value of high drug levels in the aqueous.

The effects of intraocular injections of crystalline penicillin and of preparations of isolated species of Penicillium were described on the basis of histologic studies.

REPORT OF CASES

Malignant Teratoma of the Orbit: Six and One Half Years' Observation. DR. ALBERT V. SARADARIAN, Union City, N. J.

N. R., a female, was born at St. Francis Hospital, Jersey City, N. J., at full term, with low forceps delivery. A large tumor pushed the right eyeball markedly outward.

Exenteration of the right orbit was done, the eyelids being left intact. Five weeks later 4,878 millicurie hours of radium was given.

Pathologic study showed a malignant teratoma of the orbit. Photographs were shown of the condition at birth and at the time of the report.

DISCUSSION

DR. WENDELL L. HUGHES, Hempstead, N. Y.: I have had the opportunity of seeing this child several times during her lifetime, and I think Dr. Saradarian has managed the case excellently by keeping his hands off. I do not think that any operation would improve the local condition enough to make it cosmetically presentable. The only thing that could be hoped for is to get a prosthesis that would not be too disfiguring. Of course, to get life into such a prosthesis has not yet been done, but it is something on which I hope to be working in the near future. To make it possible to move the upper lid on the side of the prosthesis in unison with the lids of the other eye should not be too difficult a problem to solve.

Lipid Dystrophy of the Cornea. Dr. Samuel Frankel and Dr. Julius Schneider.

This process is characterized by a deep interstitial fatty and cellular infiltration of the cornea. The course is usually protracted and the condition painless and bilateral, though a long interval may precede involvement of the second eye. Berliner grouped several types of fatty metamorphosis of the cornea under the heading "lipid keratitis." The primary type is caused by a purely local disturbance, or is associated with a systemic disturbance, of lipid metabolism. The secondary forms consist in a degenerative change in long-standing disease of the cornea. The underlying pathologic process is the same in the two types. Heath divided the progress of these lesions into three stages: (1) the early, active phase, (2) the mature phase and (3) the retrograde phase.

Case 1.—M. G. B., aged 47, had a small foreign body removed from the right cornea in January 1944. About eighteen months later a residual scar began to grow and has continued to progress. Examination revealed a corneal opacity in the right eye, the central portion of which was solid, yellowish gray and vascularized and occupied the posterior half of the corneal stroma. The periphery was grayish white, consisted of numerous fine crystalline bodies and occupied the anterior third of the stroma.

Case 2.—M. L. F., aged 59, had a trephination on the right eye for glaucoma, after which a corneal opacity developed. The central portion of the opacity was yellowish, amorphous and vascularized. The periphery was less dense and was slightly flocculent in appearance.

Laboratory examinations, including determination of the cholesterol and the uric acid level of the blood, gave normal results in both cases.

DISCUSSION

Dr. Arnold Knapp: Lipid disturbances of the cornea are important and extremely interesting, and it is timely that more of these cases are put on record. Am I correct in understanding Dr. Frankel to say that the blood cholesterol was normal in both cases? Has he been able to accomplish anything with treatment?

Dr. Gerard De Voe: I want to ask about the use of corneal transplants in treatment of these conditions. Dr. Castroviejo has stated that in his experience transplantation is not indicated because the condition usually recurs in the transplant. I wonder whether any one else has had a similar experience.

Dr. Samuel Frankel: The blood cholesterol was within normal limits in both cases. Katz and Delaney, in discussing dystrophia adiposa corneae, and Heath, in his report on lipid interstitial keratitis, stated that studies of the blood cholesterol are inconclusive. In the majority of cases reported the blood cholesterol has been normal. In cases of lipid nephrosis, in which the blood cholesterol is high, corneal changes are usually absent. On the other hand, in cases of lipid dystrophy of the cornea, in which the blood cholesterol is normal, no estimation is made of perhaps more important fats which are present in the blood stream.

Treatment consists in attempting to trace and correct the underlying cause. Neither of our patients had any systemic disturbance of fat metabolism. No endocrine imbalance was found. Search for foci of infection gave negative results. The patients were placed on a diet low in fat and carbohydrate but showed no improvement. A corneal transplant was considered in case 1 but was not deemed advisable at that time because correctible vision in the affected eye was 20/40.

Wright (1936) reported a case of bilateral involvement in which keratoplasty was employed. The graft took successfully in one eye, whereas the other underwent fatty infiltration.

PAPER OF THE EVENING

Clinical Disturbances of the Oculomotor System. DR. DAVID G. COGAN, Boston.

Several oculomotor syndromes of clinical interest were presented and illustrated with moving pictures and lantern slides.

The first syndrome was internuclear ophthalmoplegia. It was pointed out that the manifestations were adequately explained by postulating a lesion in the medial longitudinal fasciculus; as illustrated by the 2 cases presented, there was a variation in the associated signs, depending on whether the lesion was situated anteriorly or posteriorly in the tract. In the cases presented the cause was multiple sclerosis.

The second syndrome, called "spasm of the near reflex," consisted in intermittent convergence, myopia and miosis. The etiologic factor in the cases presented was hysteria, and 2 of the patients were "cured" by lenses of negative dioptic power.

In the third syndrome, called "oculomotor short circuits," some of the ocular muscles are presumed to become innervated by nerves other than those originally intended. The cases illustrating this condition were those of (1) aberrant regeneration of the third nerve, (2) the jaw-winking reflex and (3) an unnamed anomaly, in which there were a rhythmic upward and downward movement of one eye and a simultaneous extorsion and intorsion of the other eye.

The fourth, and final, syndrome was that of pseudo-ophthalmoplegia in infants, with a characteristic paralysis of voluntary lateral gaze but with preservation of haphazard gaze. The conspicuous feature in the 2 cases illustrating this syndrome was a peculiar jerk of the head, by which the infant attempted to compensate for the oculomotor disturbance. Noteworthy, also, was the absence of the fast phase of labyrinthine nystagmus.

DISCUSSION

DR. HAROLD W. BROWN: In a relatively few minutes, Dr. Cogan has shown through moving pictures and slides, classic cases of these various syndromes, which must have taken him years to collect and classify. The first slide, showing the neuroanatomy of the oculomotor nerves and their connections with the conjugate centers of lateral gaze, of convergence and of accommodation through the medial longitudinal fasciculus, has enabled us to follow the neurologic explanation of these interesting syndromes and will surely help us to recognize cases of these disturbances when we encounter them.

Marshall and Laird (AM. J. OPHTH. **19:** 1085 [Dec.] 1936) reported 100 cases of multiple sclerosis. In their series, about 10 per cent of the patients had oculomotor disturbances; about 6 per cent had paresis of individual muscles, and 4 per cent had paresis of conjugate movements. The authors cited extensively from the cases in the literature, in the majority of which paresis or paralysis of individual muscles was present. In about 30 or 40 per cent of the cases in one series there was a history of transient diplopia. This would fit in well with Dr. Cogan's explanation of these transient pareses, either of conjugate movements or of individual muscles. I have had several cases in which oculomotor dysfunction was associated with multiple sclerosis; in 1 case in particular there was a paresis of divergence. I should like to have Dr. Cogan tell us something about the divergence center—whether or not it exists—and, if so, its approximate location and whether, in his experience, multiple sclerosis is a common cause of divergence paralysis.

The condition that Dr. Cogan calls spasm of convergence, or the convergence reflex, is always thought of in terms of accommodation. The few cases of the disturbance that I have seen were in young girls and were always associated with neurosis or hysteria.

Dr. Cogan states that aberrant regeneration of the third nerve, in which there was paralysis of both elevator muscles of the eye, was usually due to birth injuries. In the cases which I have had, with paresis or paralysis of both elevator muscles, with or without ptosis, there was usually a history of prolonged labor, and at times scars or forceps marks were present on the head. I have followed several of these patients, whose paresis seems to improve as they get older. First, there is complete ptosis, and the eye cannot be raised to the horizontal position; as time goes on, both the levator of the lid and the elevator muscles of the eye function well enough to open the eye partially and raise the eyeball above the horizontal position.

I should like to ask Dr. Cogan whether he has observed any improvement in a paralyzed muscle in the cases he has classified under aberrant regeneration of the third nerve.

DR. HENRI BIRNBAUM: I should like to ask how the patients with spasm of convergence act after instillation of atropine.

DR. D. M. ROLETT: I should like to ask whether a caloric test was done in the last case. It seemed to me that the rotatory movement had the value of the Bárány test, and I wonder whether the disturbance in this case was not associated with nystagmus.

DR. DAVID G. COGAN: First, in regard to Dr. Brown's point about divergence paralysis: As you know, the problem of the localization of a divergence center is a hardy perennial. Fortunately or not, depending on the point of view, there is rarely an opportunity for autopsy on patients who have a sufficiently discrete lesion to mean anything. I know of only 3 cases with autopsy in which divergence paralysis was one of the clinical manifestations. In 1 case there was a hemangioma in the midbrain, and in the others lesions of the cerebellum were present which may well have pressed on the floor of the fourth ventricle. It is hard to fit that localization in with the many conditions which cause divergence paralysis. I had the interesting experience of finding a typical divergence

paralysis in a patient with polyneuritis, with no evidence of intracranial disease other than the paralysis. I had another interesting case in which there was a divergence paralysis with Wernicke's disease. Subsequently this patient had a convergence paralysis, suggesting a relationship between the divergence and the convergence center. As to the localization of the center, I have nothing to offer that is illuminating. I do not recall having seen divergence paralysis associated with multiple sclerosis.

As to improvement of the ocular movements following aberrant regeneration of the third nerve, the history in most of the cases presented this evening indicated that the anomaly was congenital, there having been a ptosis at birth, with spontaneous elevation of the eye beginning in three to five months. But when the patient was seen at the age of 5 years or older, the condition was stationary.

As for treatment of spasm of the near reflex, atropine "cures" it, just as do minus glasses; another effective means of treatment is prisms, base out. The use of minus glasses seemed to be the most compatible with school work.

As for the presence of congenital nystagmus in babies with pseudo-ophthalmoplegia, these patients had no nystagmus. Rotating the patients as I did was analogous to a Bárány test; this resulted in a maintained deviation of the eyes to one side, there being a characteristic absence of the fast phase of labyrinthine nystagmus.

Book Reviews

Ophthalmology in the War Years. Edited by Meyer Wiener, M.D. Volume 1 (1940-1943). Price, $13.50. Pp. 1166. Chicago: The Year Book Publishers, Inc., 1946.

The idea of a review of the literature on ophthalmology during the war years was suggested to the Subcommittee on Ophthalmology of the National Research Council, who were fortunate enough to get Dr. Meyer Wiener to act as editor in chief. As Dr. Wiener says in the preface, the task of securing associate editors under present conditions was particularly difficult, as can be easily understood. Yet the subdivision of the work and the excellent selection of co-editors reflects great credit on Dr. Wiener. The book brings a bibliography and an abstract of the important articles, as well as a general review, of each subject which appeared in the literature from the years 1940 to 1943. Unfortunately, the literature from Great Britain and from the Continent could not be included in this volume, but the literature from Latin America was available, thanks to the excellent cooperation of Dr. Moacyr Alvaro and his associates. The table of contents lists the following subjects and the respective authors:

"Anatomy and Embryology," John J. Prendergast; "Aqueous Humor," Jonas S. Friedenwald; "Biochemistry, Pharmacology and Toxicology," David G. Cogan and W. Morton Grant; "Color Blindness," Louise L. Sloan; "Comparative Ophthalmology," Helenor Campbell Wilder; "Congenital Anomalies," Arthur M. Yudkin; "Conjunctiva," John G. Bellows; "Cornea and Sclera," Ramon Castroviejo; "Electrophysiology," S. Howard Bartley; "Experimental Pathology," Peter C. Kronfeld; "General Pathology and Bacteriology," Georgiana Dvorak-Theobald; "Glaucoma," Otto Barkan; "Hygiene, Sociology, Education and History," Windsor S. Davies; "Industrial Ophthalmology," Hedwig S. Kuhn; "Injuries," Robert J. Masters; "Instruments and Apparatus," H. Rommel Hildreth; "The Lens," Ray E. Daily and Louis Daily Jr; "Lids and Lacrimal Apparatus," Harold F. Whalman; "Methods of Examination," Leo L. Mayer; "Neuro-Ophthalmology," P. J. Leinfelder; "Ocular Muscles," George P. Guibor; "Orbit, Eyeball and Sinuses," William L. Benedict; "Physiologic Optics," Hermann M. Burian and Kenneth N. Ogle; "The Pupil," Henry Minsky; "Refraction and Accommodation," E. Merle Taylor; "Retina and Vitreous," Hugo Lucio; "Surgery of the Eye," Bennett Y. Alvis; "Systemic Diseases: Syphilis, Parasites," Joseph Igersheimer; "Therapeutics," Frederick C. Cordes and Samuel D. Aiken; "Trachoma," Phillips Thygeson; "Tumors," Algernon B. Reese; "Uveal Tract," William M. James.

It is at once apparent that the subject has been admirably subdivided and that Dr. Wiener was fortunate enough to obtain an expert to review each part. The many references that are given in the bibliography are astonishing, and it is clear what a laborious undertaking their examination must have entailed. The critical reviews in each

chapter are particularly excellent and useful. The second volume will include the literature beginning January 1944, and ending in June 1946.

The book making is excellent, with good paper and distinct type. The author and his co-editors are to be congratulated on the successful outcome of this volume. The second volume, on its appearance in 1947, will complete a most useful and excellent summary of ophthalmologic literature of a part of the world during the war years.

ARNOLD KNAPP.

Die Erkrankungen des Augenhintergrundes (Diseases of the Fundus). By Professor Adalbert Fuchs. Pp. 287, with 66 illustrations in colors on 44 plates. Vienna: Franz Deuticke, 1943.

From lectures, and with the addition of a number of pictures of unusual, yet characteristic, cases of diseases of the fundus, the author has compiled this book to serve as an aid to physicians and oculists, without attempting to write a formal handbook with many literary references. The typical diseases as they relate to internal medicine, neurology, dermatology, surgery and pediatrics are briefly but clearly described, with particular attention to the fundus pictures and the subjective symptoms, and a complete index is added. The author emphasizes that, in addition to the fundus picture, knowledge of the anatomy of the lesion is of the greatest aid in the diagnosis of a disease of the fundus. He has therefore added many histologic sections which are easily recognized by the specialist without going into minute histologic details, and which serve their purpose best in the form of drawings, rather than of photographs.

The book is divided into chapters dealing with the following subjects: varieties of the normal fundus, congenital anomalies, diseases of the optic nerve, glaucoma, tuberculosis of the posterior eyeball, syphilis of the posterior eyeball, myopia, tumors, retinal detachments and injuries.

The author has succeded in covering an important and most interesting part of the diseases of the eye in a book which serves admirably as an addition to the usual textbook. The plan to illustrate the ophthalmoscopic appearance of each lesion with the associated histologic picture is unique and will be found most useful and instructive by every student of ophthalmology. The print and paper are excellent, and the drawings and histologic pictures of the fundus, in color on forty-four plates, reflect great credit on the artist, Hugo Keilitz. ARNOLD KNAPP.

Lehrbuch der Augenheilkunde. Seventeenth edition. Edited and enlarged by Dr. Adalbert Fuchs. Pp. 916, with 362 illustrations and 5 colored plates. Vienna: Franz Deuticke, 1943.

Dr. Adalbert Fuchs took over the editorship of Ernst Fuchs's well known textbook and a new edition appeared in 1939. Notwithstanding the change that had taken place in the character of diseases of the eye in recent decades, especially in the severe forms of corneal ulceration and conjunctivitis, the description of the external diseases was not curtailed. On the other hand, Fuchs recognized the advances that have taken place in knowledge of diseases of the fundus and their relations to general medicine, so that this part of the book was enlarged. The chapters on tumors,

neurology and muscles were also added to. Inherited ocular disorders received more attention, as evidence of the large number of congenitally blind to be found in the homes for the blind. Treatment of ocular diseases was more fully described. Realizing the importance of pathology in the understanding of diseases of the eye, the author added more colored illustrations, which were taken from his excellent "Atlas of the Histopathology of the Eye."

This revised edition was so well received that a new, seventeenth, edition appeared in 1943, notwithstanding the difficulties of the war years. A number of new illustrations have been added in this new edition, and among the new features the important treatment with sulfonamide drugs must be mentioned. A desirable and useful addition is a chapter describing unusual syndromes in which general conditions are associated with ocular symptoms. These are frequently spoken of in the medical literature of today, and their descriptions are often not easily found in the usual medical textbooks.

The paper and printing are excellent. ARNOLD KNAPP.

Journal of Gerontology. Volume 1. Number 1. Published quarterly for the Gerontological Society, Inc. Part 1: Annual subscription, $6; pp. 152. Part 2: Non-Technical Supplement (separately), $3; pp. 84. Springfield, Ill.: Charles C Thomas, Publisher, 1946.

This new arrival in periodicals, dealing with the various aspects of aging, physiologic and pathologic, their social and medical implications, purposes "to add life" to years, not just years to life—surely a laudable aim, if not just a *pium desiderium*.

Part 1 presents a number of interesting, if somewhat disconnected, chapters, entitled, "Gerontology," by Lawrence K. Frank; "Logarithmic Increase in Mortality as Manifestation of Aging," by Henry S. Simms; "Relation Between Age of Stem Tissue and Capacity to Form Roots," by P. W. Zimmerman and A. B. Hitchcock; "Aging in Nutritionally Deficient Persons," by Tom D. Spies and Harvey S. Collins; "Prolongation of Life with Prevention of Leukemia by Thymectomy in Mice," by Jacob Furth; "The Hodson Community Center," by Dora Fuchs and Harry Levine; "Budgeting for Social Security," by W. R. Williamson; "Attitudes Toward Aging and the Aged: Primitive Societies," by Leo W. Simmons; "Involution of Tissues in Fetal Life," Arthur T. Hertig; and, finally, "Shakespeare's Attitude Toward Old Age," by John W. Draper. To each of these chapters is appended an abstract in English, French, Spanish and Russian, a rather significant indication of the trend of the times.

The non-technical supplement (part 2) abstracts these articles practically unchanged; however, it presents in addition, under the heading of "Current Comment," a number of lighter items, such as "The Fountain of Youth," "The Debt of the Survivors," "Surgery for the Aged," "Shaw and Beveridge," "Fun at Sixty," *et tutti quanti*.

There are book reviews, too, a list of books received, an index of current periodical literature (on gerontology) and a glossary. Varied fare, indeed, which may interest those who, as Draper notes, like to browse through the ages, meaning in medical by-ways, and may appeal to ophthalmologists here and there, even if they are not concerned with the practical implications of gerontology.

PERCY FRIDENBERG.